The Electrical Industry's Weekly Magazine

February 6, 1961

Electrical World

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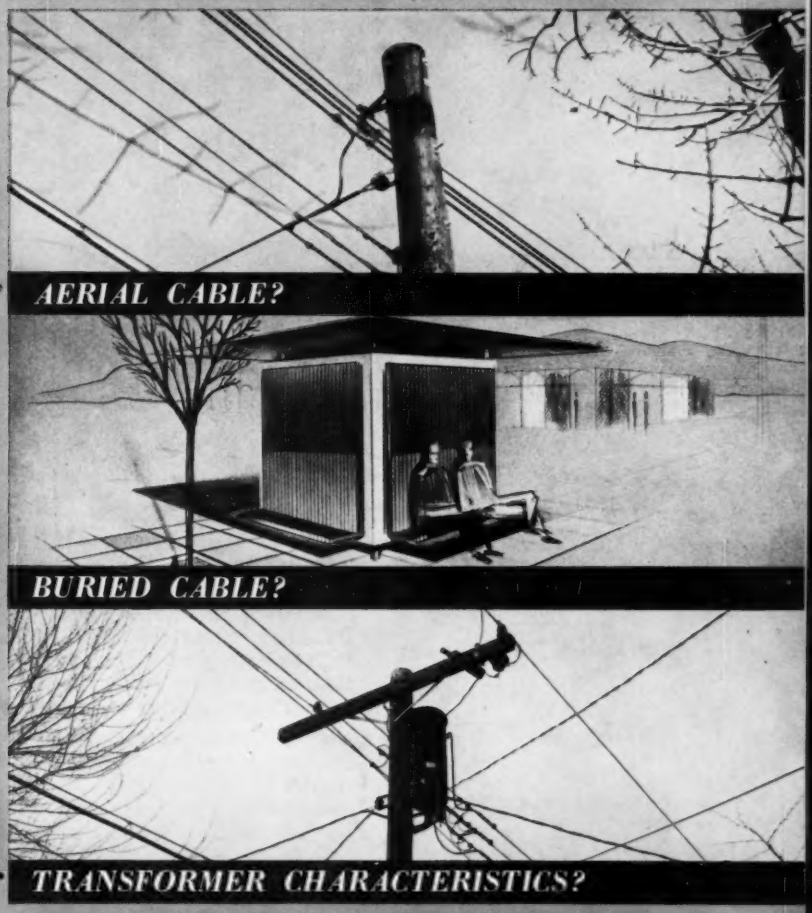

What do we need in . . . . . .

Distribution for the Future

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UNIV MICROFILMS INC
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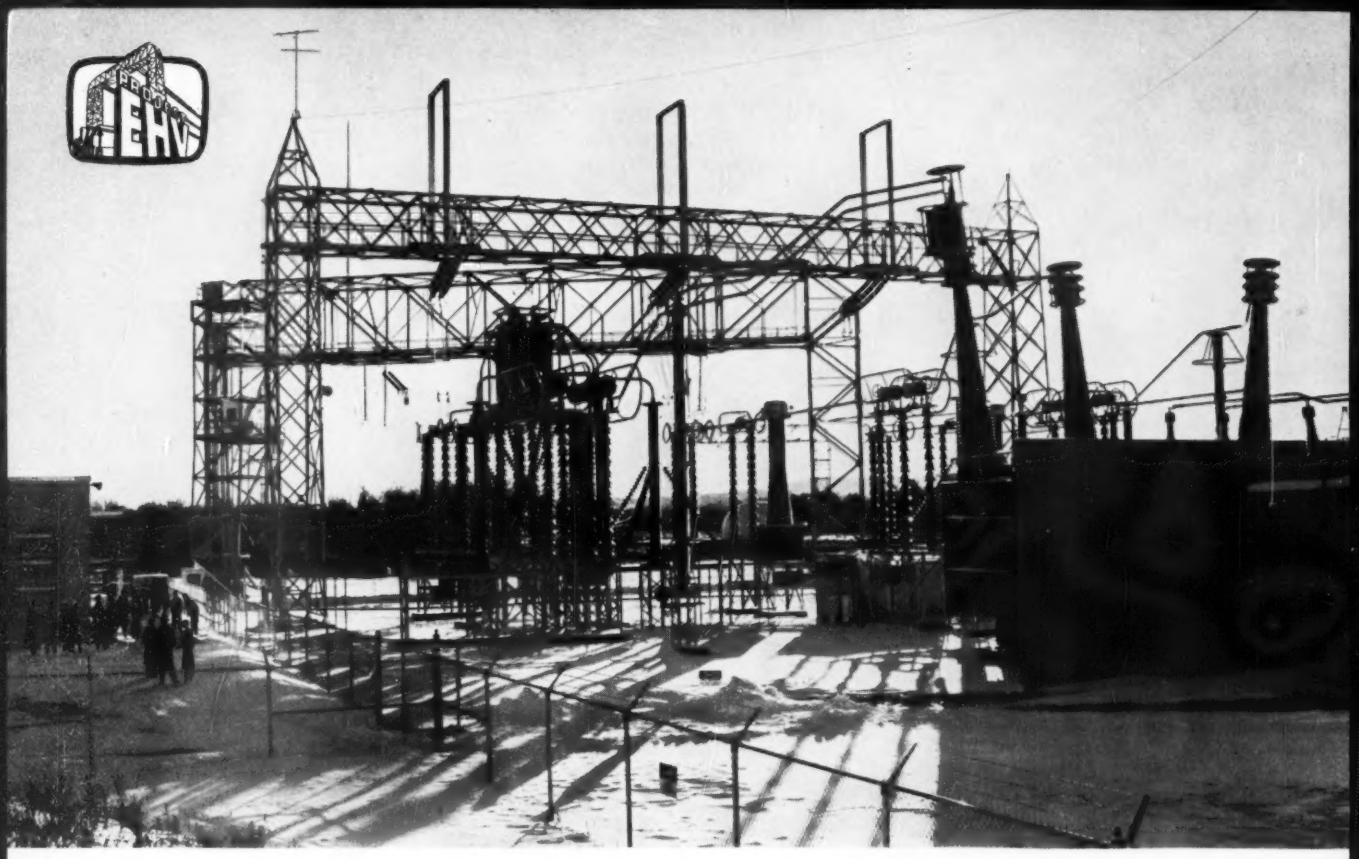

PROJECT EHV IS ENERGIZED

Super-voltage Research Will Help Solve Transmission Problems

H. J. Cadwell, President of Western Massachusetts Electric Company, energizes Project EHV as R. L. Gibson, Vice President of G.E., cuts ribbon.

720,000 VOLTS, the highest voltage ever attained on a transmission line, were recorded on December 8, 1960, during energizing ceremonies at the north section of Project EHV, a giant outdoor laboratory located near Pittsfield, Massachusetts. The objective for the 4.3-mile, prototype extra-high-voltage power system: to increase knowledge of EHV transmission, thus helping electric utilities to satisfy efficiently and economically the nation's soaring demand for electricity.

ADVANCED EQUIPMENT at the $7½-million Project includes a 650-kv, 40-mva power transformer, four 650-kv disconnect switches, and eighteen towers of four materials and nine designs. More than 260 instruments are now recording or being installed to record electrical, meteorological, and mechanical data (10 million readings annually) for computer processing.

TESTING will be conducted at 460 to 500 kv until mid-1961 and at 650 to 750 kv after that. In late 1962 the line will be integrated with the adjoining Western Massachusetts Electric Company system to obtain operating experience as well as further test data.

ELEVEN COMPANIES* have joined General Electric to build this system. Two advisory groups, one composed of executives of fifteen American and Canadian utilities and the other of fourteen consulting engineers, are taking an active part in guiding research. Project EHV is an outstanding example of co-operation by utilities, consultants, and manufacturers to help solve load growth problems. 604-04

*Aluminum Company of America
Aluminium Limited
American Bridge Division, US Steel
Anchor Metals
Brewer-Titchener Corp.
Commonwealth Associates
Petersen Engineering Co.
Prestressed Concrete Institute
Rilco Laminated Products Division, Weyerhaeuser Co.
Stone & Webster Engineering Corp.
Western Massachusetts Electric Co.

GENERAL ELECTRIC

Published for 87 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Electrical World

FEBRUARY 6, 1961

Vol. 155, No. 6

Electrical What in the World . . .

We've just read a book which we can recommend to everyone in the electrical power business—and especially to those who entered it post-FDR. "S. Z. Mitchell and the Electrical Industry" gives an incisive view into an era that is today clouded badly by years of emotionally loaded words. The biography was written by Sidney Alexander Mitchell, S. Z.'s son, and published by Farrar, Straus and Cudahy.

Sidney Zollicoffer Mitchell was a vital figure in the power industry from the day he met Edison in 1885 until the late Thirties. He founded—and steered—Electric Bond & Share through the turbulent early growth of the industry. And his financing and engineering approaches set many patterns still with us today.

The book takes the tack that no apology is needed for the early electric utility holding companies, and we believe this is the volume's greatest weakness. That some holding company operations were improper is recognized, and the Mitchell story prefers to ignore the point. It would have been stronger otherwise.

But it does give a valuable description of the potent role the holding companies play in breathing life into many utility operations that could have survived in no other way under private enterprise.

We don't think many people now in power work understand this role well enough. This unemotional book can provide invaluable information to aid such understanding.

Chuck Hochgesang

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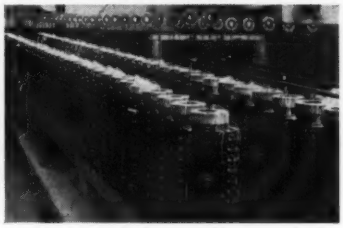
Exclusive Lapp Process Stabilizes Power Factor and Loss in Post Insulators

A LAPP LABORATORY REPORT

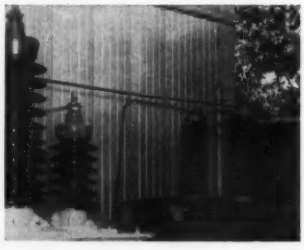
THE PROBLEM: Line Post and Station Post insulators occasionally have been found to show variation in power factor, charging current and watts loss under Doble tests. Field service seems not to have been impaired, but the phenomenon has been noticeable in such instances as erratic readings secured in tests of bushings connected to Post insulators.

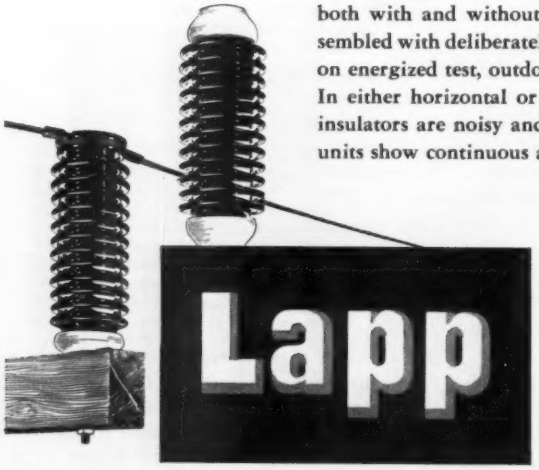
THE FINDING: Some years ago engineers of the Lapp Laboratory staff were assigned the job of tracing down the cause of such variations. It was located and identified as contamination deposits on the inside walls of the insulators. Porcelain bodies for Lapp Post insulators are subjected to a severe test for electrical soundness—a 3-minute flashover from the inside of the head around the body to the outside of the head. During this test the hole in the insulator fills with corona, and contaminating particles deposit on the walls of the hole; amount of this deposit and its effect on electrical characteristics vary with atmospheric conditions at the time of the test and at the time of plugging the hole for assembly.



THE SOLUTION: A thin coating of silicone applied to the wall of the insulator hole negates the effect of the corona contamination, and results in insulators dependably uniform in power factor, charging current and watts loss. Permanent effectiveness of the silicone coating is assured by its inherent chemical stability, and by the fact that the hole to which it is applied is sealed by the Lapp plug against weather, light, heat, or other physical or electrical attack. A Lapp patent is pending on the process.

THE VERIFICATION: All Lapp Line Post and Station Post insulator production for more than three years has incorporated the silicone treatment. The low initial power factor of the insulator has been maintained on every unit re-tested after service. In addition, in an effort to determine limits of effectiveness of the process, a series of insulators has been set up in the Lapp laboratory. Post insulators, both with and without the silicone treatment, were assembled with deliberately-defective plugs. They have been on energized test, outdoors, continuously for three years. In either horizontal or vertical mounting, all untreated insulators are noisy and show high loss. Silicone-treated units show continuous and unchanging low loss.





THE CONCLUSION: To the widely-known advantages, in electrical and physical performance, of its Post insulators, Lapp research has added the characteristic of stability in power factor, charging current and watts loss. *At Lapp, insulator design and production is a matter of continuous development and improvement.*

Lapp Insulator Co., Inc., Le Roy, N. Y.

Electrical World

Letters

What Caused Cylinder Cracking?

To the Editor:

We note with some interest a letter to the editor titled "Disagree on Cylinder Cracking" by an Allis-Chalmers man in your issue of Dec. 5, 1960, p 5.

Reading this article leaves one with a strong impression that Allis-Chalmers turbines are free from cracking problems. We have six Allis-Chalmers turbines ranging in size from 10 Mw to 44 Mw. We recently rebuilt our No. 9 machine which is a 35-Mw unit operating at 900-lb psi and 900F superheat.

During this rather extensive rebuilding program we found 108 cracks in the high pressure cylinder. Sixty of these were sufficiently serious to require grinding and rewelding. A few of the cracks extended to within a fraction of an inch of the outside of the case. . . .

Chadwell O'Connor, Chief Mechanical Engineer
Municipal Light & Power Dept
Pasadena, Calif.

Our Correspondent Replies

To the Editor:

Since receiving your Jan. 9 letter and Mr Chadwell O'Connor's comments, we have carefully reviewed repairs made at Pasadena. These cylinder cracks were in no way related to thermal cycling, but resulted from incipient flaws in the casting.

Our previous remarks, as published in your "Letters Column," clearly state that Allis-Chalmers has a record of "no cylinder cracking in the nozzle area due to thermal stresses brought about by cyclic duty. . . ."

This statement was prompted by Mr Stinton's article (EW, Oct. 24, 1960, p 46) which claimed that such cracking is now an industry-wide problem. It was not our intent to disassociate ourselves from all other types of cracking, many of which would have been originally detected and repaired with today's quality-control methods.

We hope this clears up any misunderstanding remaining on the subject.

D. J. Nairn
Manager Product Sales
Thermal Power Dept
Allis-Chalmers Mfg Co

Dateline . . .

Washington, D. C.—One of Interior Secretary Stewart Udall's first actions was predictable, if not somewhat confusing. He has asked FPC Chairman Jerome Kuykendall to give back and forget the Department's previous estimates showing that neither of the rival Nez Perce and High Mountain Sheep projects need to be built at this time.

The Interior Department, under former secretary Fred Seaton, had recommended that neither of the projects would be needed "at this time or for some years to come." That recommendation was based on a 10-year estimate of the Pacific Northwest's power needs and capacity, prepared by the Bonneville Power Administration. Bonneville estimated the west group of the Northwest Power Pool would have a surplus every year through 1970, with the addition of 1,700 Mw of prime power, to be made available through proposed joint development of the Columbia River in Canada and the US.

Seaton's recommendation was a blow to both Pacific Northwest Power Co and Washington Public Power Supply System. Neither agreed with Bonneville's estimates, yet the weight of the Interior Department was certain to be felt at the FPC. So the two rival applicants asked for Bonneville's data to be placed on the record and a Bonneville spokesman to be questioned on the record, so that Interior's recommendation could be properly challenged and perhaps knocked down.

The data was supplied to the FPC, and that same data is what Udall called back.

Udall's action was predictable because the Interior Department, now headed by officials who are more public power-minded, would hardly want to be associated with an estimate that could hurt the chances of a major public power project, even if the same estimate hurt an investor-owned project.

Udall's action was also confusing because: **(1)** He

(*Continued on page* 40)

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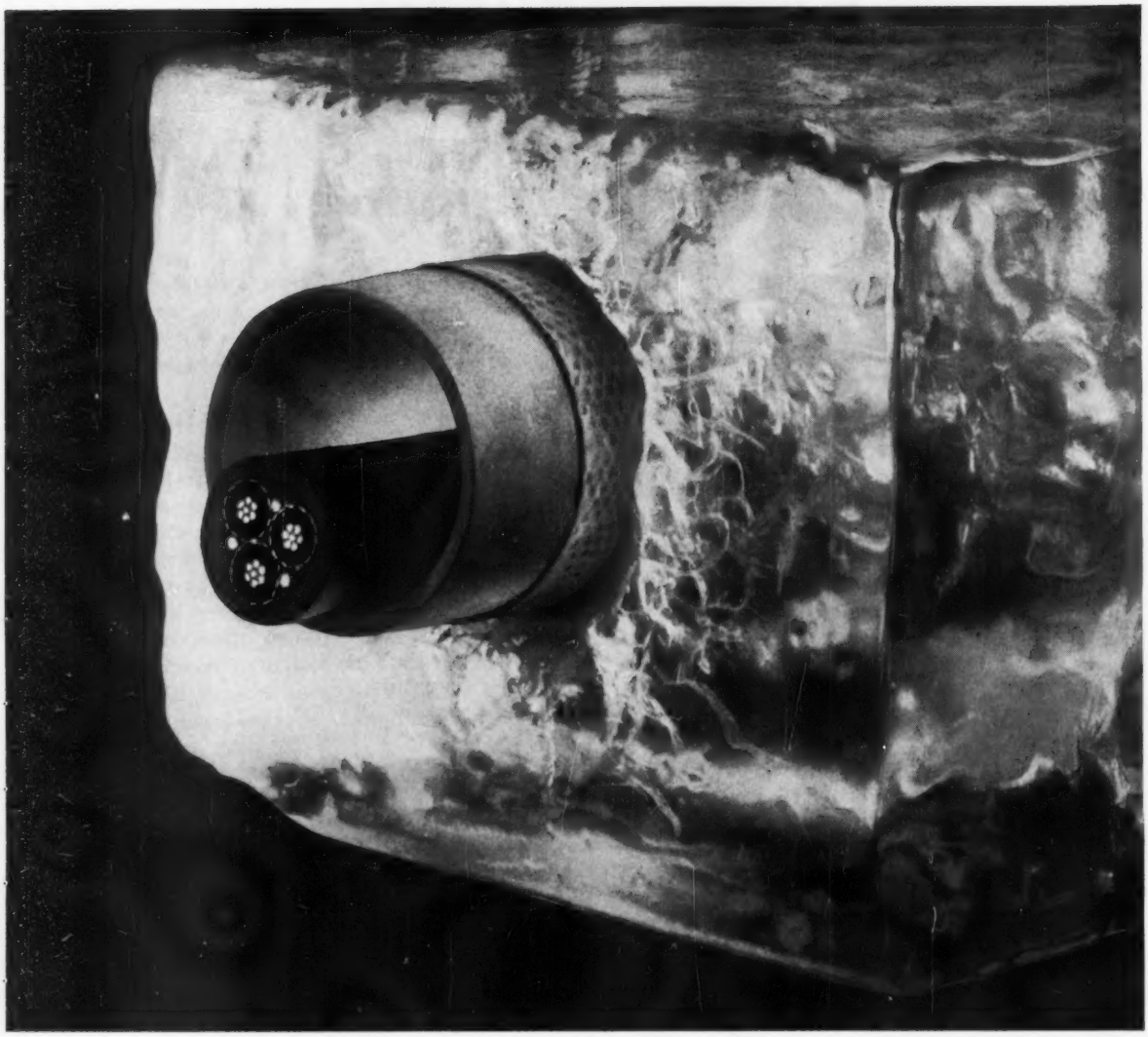

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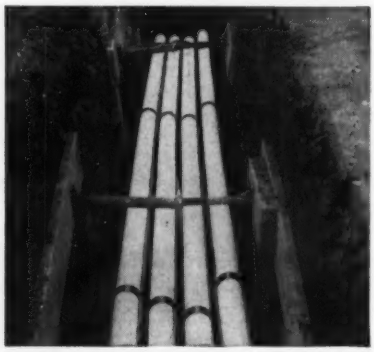
Because of their 10′ lengths and speedy coupling method, Transite Ducts can be installed at the lowest cost. Get the full story by writing Johns-Manville, Box 14, TW-2, New York 16, N. Y. In Canada: Port Credit, Ontario.



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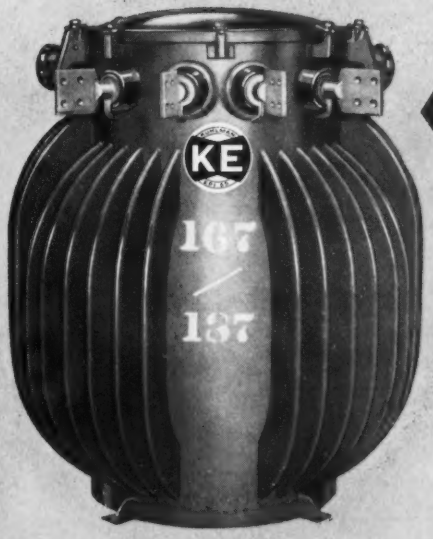
And type B (two bushings) feature famous low-loss Bent Iron Core, compact coil, Quick-Grip bushings, celuclad covers, SPI-65 super insulation and dual-ratings.

CONVENTIONAL "TYPE A"

Representing 67 years of quality manufacturing, this modern version of the first Kuhlman transformer built in 1894, features "Quick-Grip" bushings and all the latest Kuhlman improvements.



LIGHTWEIGHT "167"

Now, lighter than ever with lower losses. Core and coil have been redesigned for greater economy. New designs weigh 1500 lbs. Dual ratings 167 and 187 KVA are offered.

COMPACT 25 KVA

Height 36½ inches including bushings. Width 22 inches. Depth 21¼ inches. Greater compactness puts more KVA per pound on pole—allows change-outs to higher KVA on existing poles.

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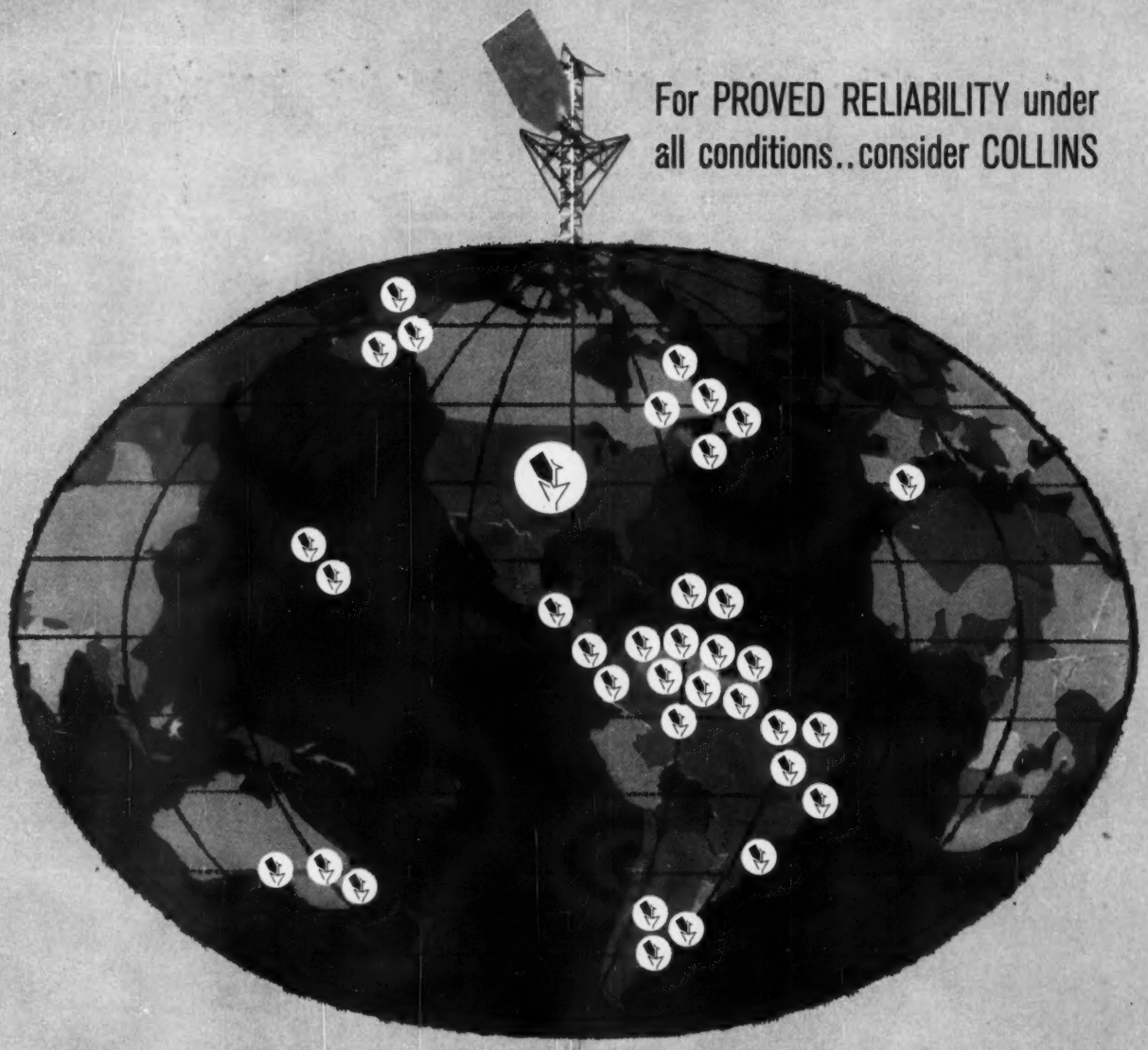

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Nothing has been changed in the traditional fine quality of the Orangeburg product. New *klean-kote* is just what the name implies — *a clean coating*. Beneath it lies the same quality product, manufactured with the same painstaking care which has made Orangeburg the best-known, best-selling line in America. Ask your wholesaler to show you a length of new *klean-kote* Orangeburg now.

Cleaner hands Cleaner clothes No irritation

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New Step Toward Economic Nuclear Power

A broad program aimed at important reductions in the cost of nuclear electric power has been initiated by the Empire State Atomic Development Associates, Inc. (ESADA). This group of seven New York electric utility companies has selected General Dynamics' High Temperature Gas-Cooled Reactor (HTGR) for intensive research and development as part of their program directed toward the construction of a large nuclear power plant in New York State competitive with conventional-type plants.

Under this program, General Atomic Division of General Dynamics will carry out research and development in extending its HTGR system to a large-scale plant of 300,000 to 500,000 kilowatts electrical capacity, which would be capable of producing the high steam temperatures and pressures required for the use of modern steam turbines.

The member companies of ESADA are:

NIAGARA MOHAWK POWER CORPORATION
LONG ISLAND LIGHTING COMPANY
NEW YORK STATE ELECTRIC & GAS CORPORATION
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
ROCHESTER GAS AND ELECTRIC CORPORATION
CENTRAL HUDSON GAS AND ELECTRIC CORPORATION
ORANGE & ROCKLAND UTILITIES, INC.

Selection of the HTGR for the ESADA program is based on progress in the development of the prototype 40,000 kilowatt HTGR plant, to be built at Peach Bottom, Pennsylvania, by Philadelphia Electric Company and 52 other utility companies comprising High Temperature Reactor Development Associates, Inc. This prototype HTGR will be the first power reactor in the nation to produce a reactor coolant outlet temperature of 1380°F., thus making possible modern steam conditions and high over-all system efficiency. In addition, the HTGR's design leads to important savings in fuel costs.

Sixty-four of the nation's investor-owned utilities are now participating in General Dynamics' programs in advanced nuclear power systems, controlled thermonuclear reactions and direct conversion of heat to electricity.

GENERAL DYNAMICS
GENERAL ATOMIC DIVISION

Illustration: two sections of nuclear assembly when brought together form critical experiment to study nuclear core characteristics of prototype HTGR.

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FEBRUARY 6, 1961
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FIRST ELECTRIC UTILITY METHODS Special Report for this year.

LATE NEWS ▸ **AEC postpones Dresden's final operating license** until March 1st. The license for Commonwealth Edison's 180-Mw nuclear powerplant would have been effective on November 21st. But control rod difficulties in mid-November prompted the commission to order the extension.

David A. Hamil, REA administrator, returns to his ranching operations in Colorado after resigning from his government duties. Hamil tells *Electrical World* that he had not been asked to resign, but when he approached the new Secretary of Agriculture, Orville Freeman, to clarify his situation under the new administration, he was told his resignation would be appreciated. He had served 4½ years of his 10-year term. Hamil's plans are to arrange business affairs in Colorado, feel out the political climate in his home state, and then vacation in Washington and New York. No successor has been named.

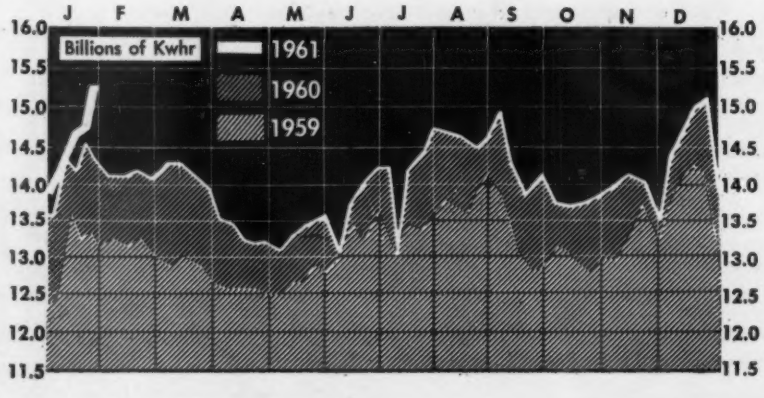
Edison Award nominees for work coming to fruition in 1960 have been named by the review committee. They are: American Electric Power Co for advancing steam plant progress; Georgia Power Co for new concepts in service entrance policies; Pennsylvania Electric Co for pioneering nation's first 460-kv transmission line; Southern California Edison Co for advanced management policies and national leadership in the installation of Medallion homes.

Northern States Power hits 3% tax on electric bills proposed by Minnesota's Governor Andersen. Company's President Allen S. King points out that consumers are already paying a disproportionate share of taxes in their electric bills. "The 3% excise tax," he points out, "would, of course, add that much to our customers' bills."

New Interior Department shapes up as Secretary Stewart Udall announces appointments. Max N. Edwards of New Mexico becomes assistant to the Secretary and legislative counsel for the Department, Graham Hollister of Nevada is special assistant to the Secretary, and Raymond G. Vendsel of North Dakota is appointed to assist the Assistant Secretary for Water and Power. Charles F. Luce, Washington attorney and former member of the Bonneville legal staff replaces Dr William A. Pearl as Administrator of the Bonneville Power Administration.

At midnight Jan. 31, Public Service E&G took over "The Society of Useful Manufacturers," an organization started by Alexander Hamilton that later became an electrical utility on the Passaic River. It was under municipal ownership.

***WEEKLY POWER OUTPUT*—Up 6.5%** (Week ending Jan. 28), Kwhr 15,361,000,000



Per Cent Change From Previous Year

	Jan. 14	Jan. 21	Jan. 28
Total U. S.	+ 3.1	+ 1.3	+ 6.5
New Eng.	+ 2.6	+ 4.7	+10.9
Mid. Atlan.	+ 2.6	+ 3.1	+ 8.0
Cent. Indust.	− 4.1	− 4.9	+ 0.2
West Cent.	+ 3.0	+ 2.8	+ 8.2
Southeast	+12.5	+ 3.8	+10.5
South Cent.	+ 5.9	+ 3.9	+ 7.4
Rocky Mount.	+14.2	+10.9	+13.3
Pacific NW	+ 0.7	− 3.3	+ 5.6
Pacific SW	+ 0.3	+ 6.5	+ 7.3

Seasonally Adjusted Index 281

Week Ago 272 Year Ago 266

Source: Edison Electric Institute

Supply Lines

PRICING MOVES MADE ON VOLTAGE REGULATORS, WELDING FITTINGS

Feeder voltage regulator prices are reduced 15% by Allis-Chalmers Mfg Co and General Electric Co. A-C made the move first on Jan. 23 when it reduced prices "15% below current published net prices." In addition, A-C said it was discontinuing list prices, multipliers, and western zone differentials. "Future pricing information for the company's complete line of JFR, SFR, and AFR feeder voltage regulators will be net prices only and will apply to all users of this equipment regardless of location." A-C said the lower prices stem from "advanced engineering designs and efficiencies due to modernized and automated manufacturing facilities." On Jan. 30, GE made a similar reduction on "all feeder voltage step regulators . . . to bring published prices more in line with market-generated price levels."

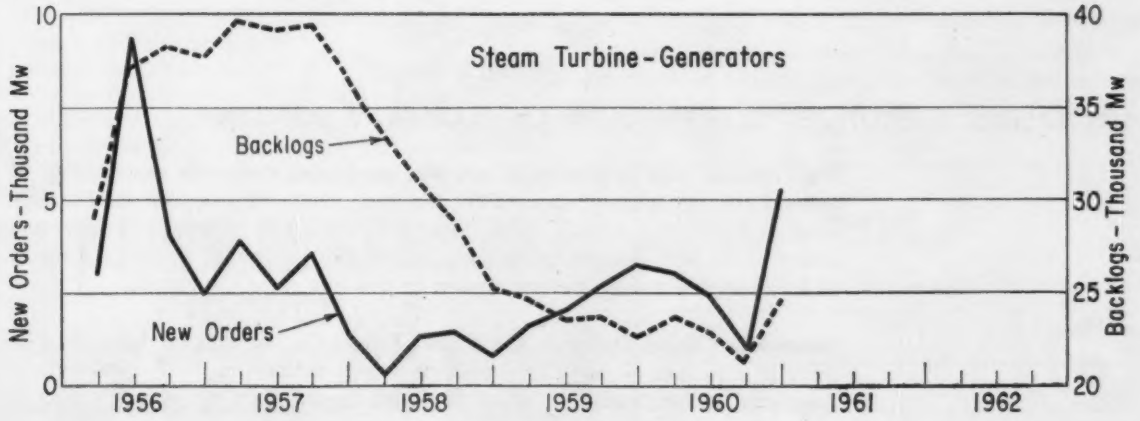
In a different field, Babcock & Wilcox Co has inaugurated a quantity pricing policy for welding fittings and flanges to encourage distributors to maintain adequate stocks and thus provide faster service. Price to users remains the same.

ENCAPSULATED DISTRIBUTION TRANSFORMERS MAKE DEBUT

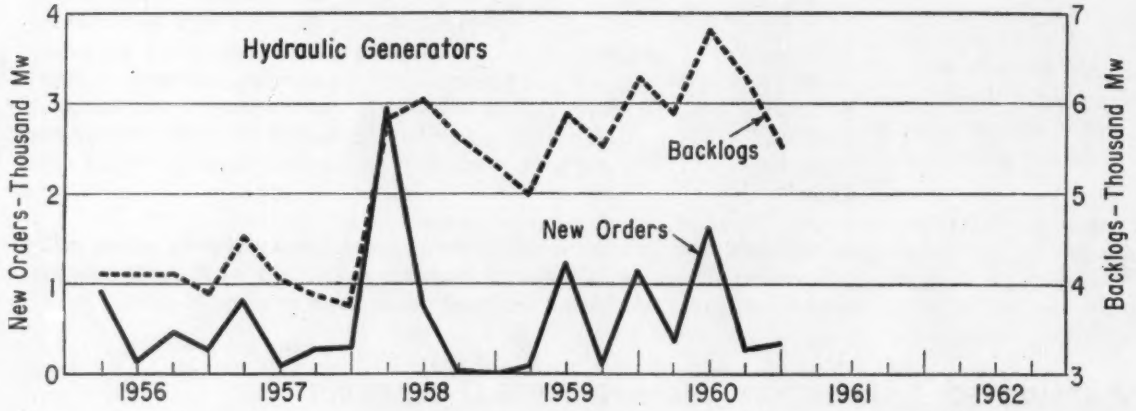
The latest thing in distribution transformers is encapsulating them in epoxy resin, as can be seen from the article on page 66 of this issue. The industry has been toying with the idea for years, but until last week none of the suppliers had been willing to take off the wraps. Then one supplier did and most others quickly followed suit. As there are still many bugs to be ironed out, sources in the industry say it will be some time before encapsulated transformers can be bought off the shelf. But watch for an immediate epidemic of field testing in this area.

EEI REPORTS RISE IN NEW ORDERS FOR SOME EQUIPMENT

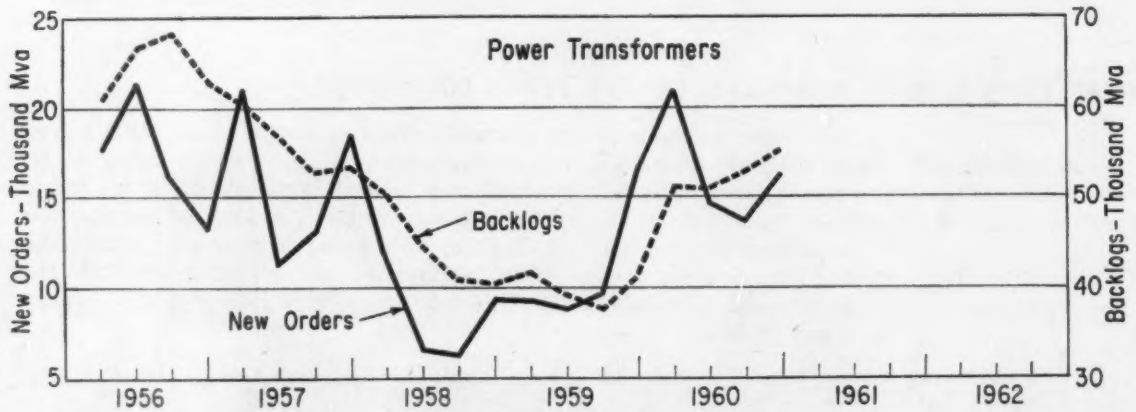
New orders for steam turbine-generators picked up sharply in the fourth quarter of 1960, the Edison Electric Institute reports in its quarterly survey of the electric power industry. The 5,188 Mw ordered in the quarter is the highest since the second quarter of 1956. Despite this spurt, backlogs of manufacturers continue to be about 60% of what they were during the peak years of 1956-57. For 1960 as a whole, some 11,542 Mw were ordered, compared with 9,607 Mw in 1959 and 3,706 Mw in 1958. (The following charts present quarterly figures issued by EEI).



For generators for hydraulic turbines, the picture is somewhat different. Backlogs during the past three years have been generally high but have been dropping during the last two quarters. New orders for all of 1960 totalled 2,681 Mw compared with 2,745 Mw in 1959 and 3,881 Mw in 1958.



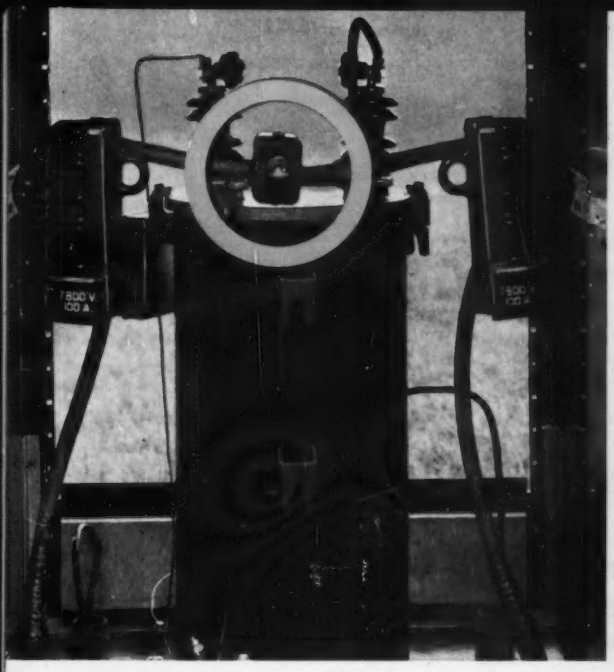
Power transformer backlogs continue to rise, having reached a low point in the fall of 1959. But the current backlog of 54,658 Mva is still well below previous peaks. New orders for all of 1960 were 64,913 Mva, compared with 43,987 Mva ordered in 1959 and 33,256 Mva ordered in 1958.



PURCHASING EXECUTIVES GLIMPSE HINT OF RECESSION BOTTOM

The recession may be bottoming out, hint purchasing executives representing all industries in the January report of the business survey committee of the National Assn of Purchasing Agents. While clear-cut evidence is lacking to indicate any change in the slow down-trend of business, a higher percentage of PA's did report increases in new orders, the first upturn in this area since last August.

Meanwhile, Chester Ogden of The Detroit Edison Co, has stepped down after six years as chairman of the Assn's business survey committee. E. F. Andrews, of Allegheny Ludlum Steel Corp succeeds Ogden as chairman.



New L-M Fault Indicator mounted on the secondary feeder in a transformer installation in an L-M Transclosure.

L-M Fault Indicator mounted on a primary feeder in an L-M Pad-Mount transformer. Indicator may be mounted either vertically or horizontally. To reset, just turn the handle. (Inset): Fault Indicator has tripped, exposing yellow section, showing that a fault exists beyond this point.

L-M's Economical Fault Indicator Quickly Locates Underground Faults

L-M's exclusive new Fault Indicator is a simple, inexpensive device primarily for installation on underground feeders in Pad-Mount® transformers or Transclosure™ housings. Should a fault occur, the Fault Indicator shows the general location, between adjacent transformers or sectionalizing points. One fault-hunting job could well pay for the installation of these L-M Fault Indicators.

The indicator can be applied to all underground circuits regardless of voltage. Over-current through the cable trips the indicator, which flips a yellow segment into view. Rating is 350 amperes nominal trip current. The indicator is mounted simply by threading the cable through the indicator yoke, and tightening the clamp.

The Fault Indicator also facilitates location of a faulted phase of a three-phase system. Fast half-cycle operation permits coordination of the indicator with protective devices over a wide fault-current range. And it costs less than $10!

Get Details On This Money and Time-Saver

Ask the L-M Field Engineer for details, and time current curves on this valuable, economical device. Or write Line Material Industries, Milwaukee 1, Wisconsin.

501

LINE MATERIAL®
Industries
McGRAW-EDISON COMPANY
Protective Equipment

DISTRIBUTION TRANSFORMERS • RECLOSERS, SECTIONALIZERS AND OIL SWITCHES
FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING
LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE AND CONDUIT

Line Material Industries,
Milwaukee 1, Wisconsin

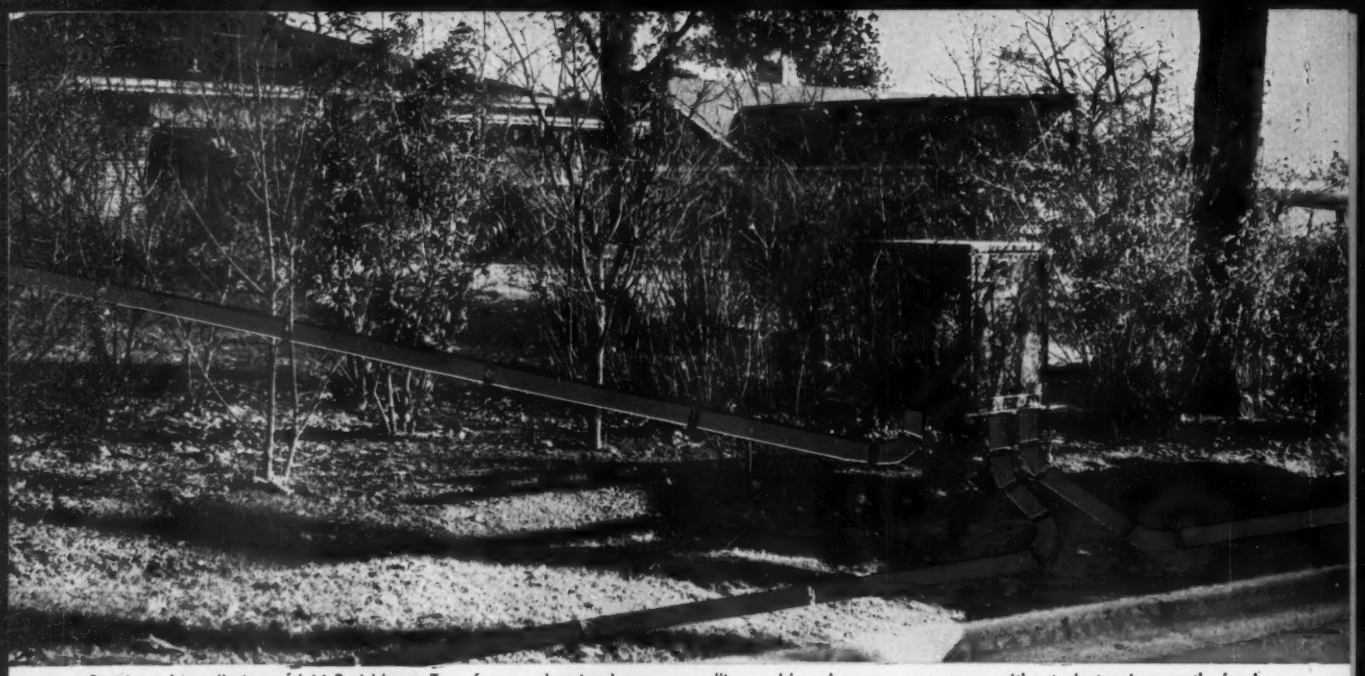
Please have L-M Field Engineer tell me how I can save time and money with the L-M Fault Indicator.

Name_____

Company_____

Address_____

City_____ State_____



Residential installation of L-M Pad-Mount Transformer, showing locations of primary and secondary runs. L-M Permaline conduit permits pulling cable whenever necessary without destroying costly landscaping and driveway pavements.

Cut Long-Range Costs Of Underground With Cable In L-M Permaline Conduit

Direct burial fibre conduit makes it easy to replace cable for faults or load growth without costly damage to customer's shrubbery and driveways.

by **W. M. BLOOM**
Product Manager, Fibre Products
Line Material Industries

Long a leader in equipment for underground distribution, Line Material recognizes the cost problem for utilities. L-M has made many contributions toward cost cutting by originating the Pad-Mount transformer; with L-M Transclosures and Power Pedestals; and with a completely engineered system for fibre conduit.

While unprotected cable offers attractive savings in original cost of an underground installation, long-range cost can be substantial, when cable must be dug up because of failures, or replacements for load growth. Replacement of shrubbery and driveways can be costly; loss of customer good will is inestimable.

Cable in Permaline direct burial conduit can be pulled and replaced easily, economically. Ask the L-M Field Engineer for information and bulletins on L-M Permaline Conduit and underground distribution equipment; or write Line Material Industries, Milwaukee 1, Wis.

Long lengths, light weight, make L-M Permaline Fibre Conduit easy and economical to install. Available in 2-4" sizes, in 5, 8, and 10-foot lengths. Complete stocks at L-M Distributors and L-M's strategically located warehouses.

LINE MATERIAL® Industries

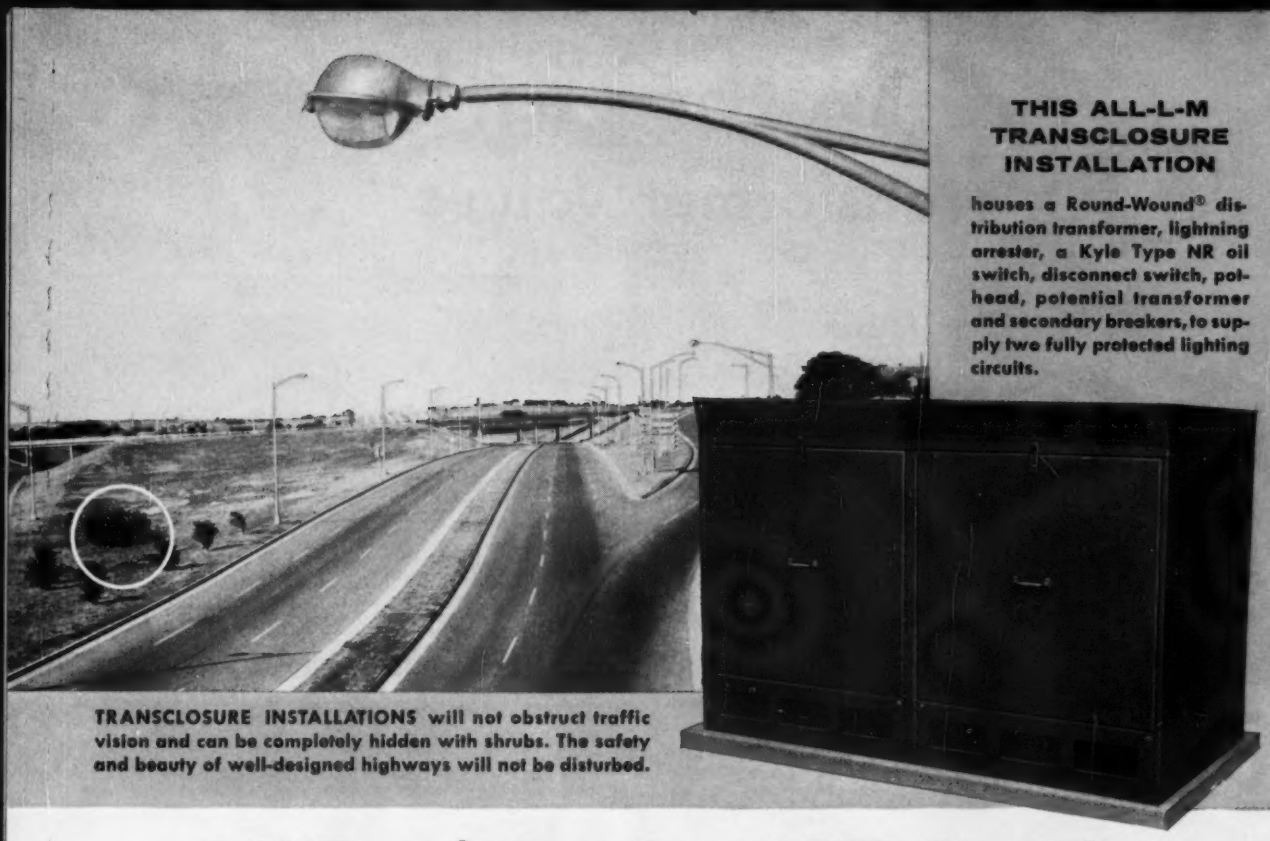
McGRAW-EDISON COMPANY

498R

Permaline Fibre Conduit

McGRAW EDISON

DISTRIBUTION TRANSFORMERS • RECLOSERS, SECTIONALIZERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS
LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT • PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS
OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE AND CONDUIT



THIS ALL-L-M TRANSCLOSURE INSTALLATION

houses a Round-Wound® distribution transformer, lightning arrester, a Kyle Type NR oil switch, disconnect switch, pothead, potential transformer and secondary breakers, to supply two fully protected lighting circuits.

TRANSCLOSURE INSTALLATIONS will not obstruct traffic vision and can be completely hidden with shrubs. The safety and beauty of well-designed highways will not be disturbed.

L-M Transclosures Save $1,750 On Each Highway Lighting Transformer Installation

Enclosure with modular construction offers savings in cost, erection time and space; permits transformer installations at the load center.

by C. W. PETERSEN, Product Manager
Line Construction Materials
Line Material Industries

Costs of expressway and highway lighting can be greatly reduced by use of the new L-M Transclosure(TM) for all transformer installations. The Transclosure will house a standard oil-filled transformer, lightning arrester, oil switch, disconnect switch, pothead, secondary breakers and potential transformer. Using the Transclosure instead of the conventional concrete block or brick housing offers an estimated saving of $1,750 per transformer installation. On a projected 60 miles of highway, where 100 to 125 installations are expected, a total saving of from $175,000 to $218,000 is anticipated.

Basically the Transclosure is a weatherproof enclosure, fabricated of heavy-gauge steel, to be mounted on a concrete pad. It houses the transformer and associated equipment. It provides ample ventilation for the transformer by means of vents at top and bottom, with baffles to prohibit entrance of all foreign objects, including wildlife. Removable primary and secondary doors can be padlocked to prevent unauthorized personnel from entering, yet they provide complete and easy access to the equipment.

Interlocking design assures a weatherproof housing; the sloped roof sheds rain. Modular construction permits ganging the units to provide whatever space is required. Units may also be expanded vertically by installation of larger side panels and bottom vents. Transclosures are available in three sizes, to accommodate transformers up to 100 kva. Small in size and light in weight, they are designed to be assembled at the job site. A complete installation, including transformer and associated equipment, has been installed with less than two man-days of labor.

The clean, low lines produce a silhouette that does not detract from highway beauty or obstruct traffic vision. Low shrubs will hide the entire installation completely. Transclosures may be installed precisely at the lighting load center, eliminating all overhead construction and producing the shortest and most economical secondary runs.

Get Complete Information

These are just a few of the reasons why many engineers are specifying this new approach to inexpensive highway lighting. For complete details, contact your L-M Field Engineer or Lighting Engineer or write me direct at Line Material Industries, Milwaukee 1, Wisconsin. 407R

LINE MATERIAL® Industries Transclosures

McGRAW-EDISON COMPANY

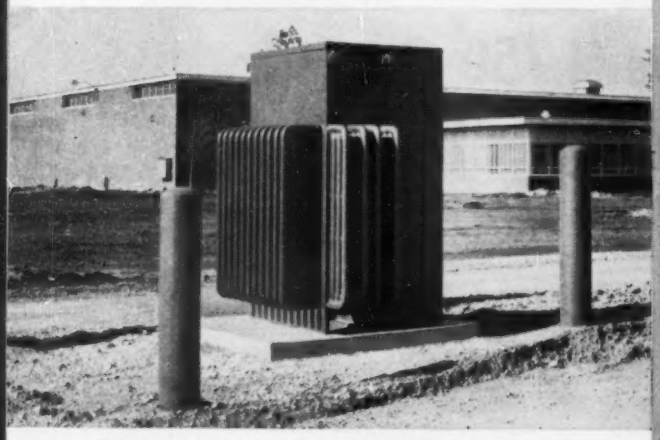
DISTRIBUTION TRANSFORMERS • KYLE RECLOSERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS.
POWER SWITCHING EQUIPMENT • PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING
LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE AND CONDUIT

McGRAW-EDISON

You Be the Judge
Of Transformer Values

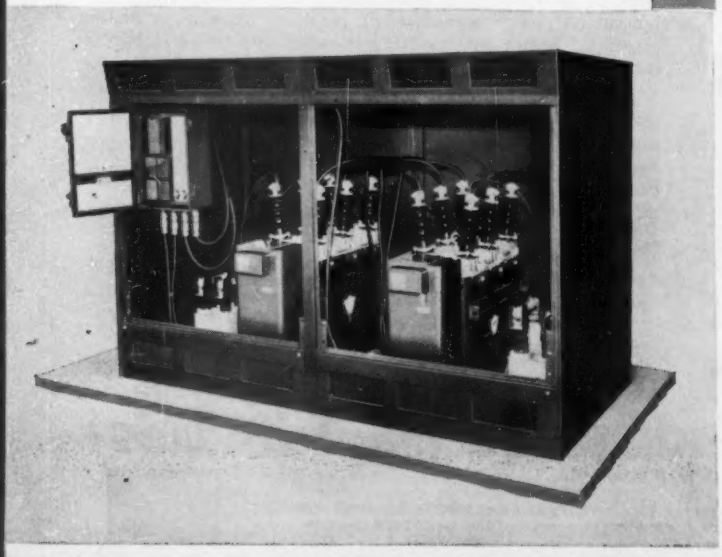
This three-phase, 500-kva, 120/208Y volt L-M Pad-Mount supplies underground service from a 13.2 kv delta primary to a shopping center area. Combining attractiveness with economy, the transformer facilitates metering of three loads from one location. Power consumed by a restaurant, an automatic 24-lane bowling alley, and an adjacent drive-in restaurant, is metered directly in the secondary compartment.

Two L-M Pad-Mounts supply power from a 13.2 kv primary to this all-electric drive-in theater. A 500-kva unit serves the concession and projection buildings, as well as the parking and exit lights. The 112-1/2-kva unit, shown here next to the businesss office, handles the office, ticket cages, marquee and entrance-way lighting. This L-M Pad-Mount is completely hidden when the decorative panel is locked in place.



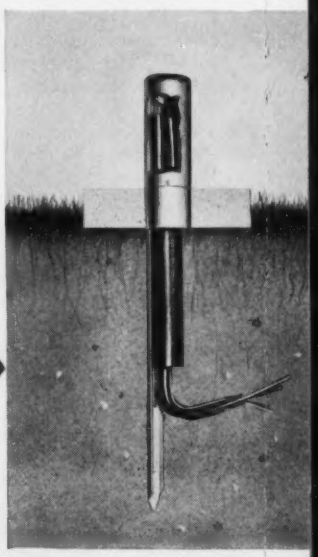
Underground service to a light manufacturing plant in a newly constructed industrial park is supplied, as shown here, by this 300-kva, 4 kv L-M Pad-Mount.

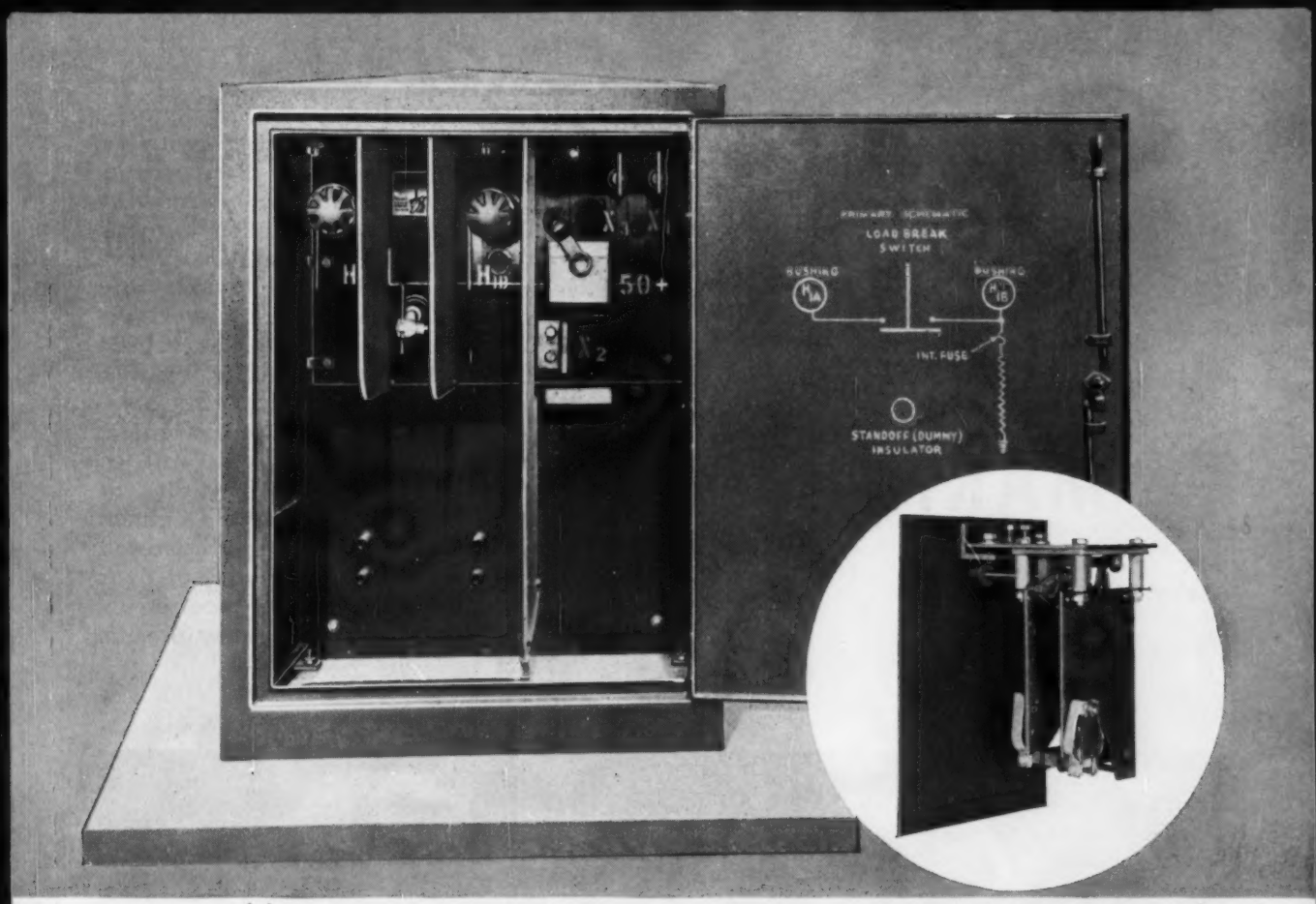
Here a single-phase, 25-kva, 120/240 volt L-M Pad-Mount (can you find it?) supplies power from a 7.2 kv primary to five heavily electrified homes in this beautifully landscaped high-income residential area.



Another economic solution for cutting underground costs is the L-M Transclosure housing. Originally designed for either standard single or three-phase pole-type distribution transformers, it can also be used singly or ganged, as shown here, to provide as much space as is needed for switching and protective devices. Transclosure housings are well ventilated, but safely closed, with locked, tamper-proof steel door panels.

L-M Power Pedestals, used with L-M Pad-Mount Transformers and L-M Transclosure housings, provide rain-proof, tamper-proof facilities for above-ground connection of secondaries. Various types, including fusible, and terminal designs are available.





L-M 50-kva Pad-Mount Transformer. Primary section, left, has stand-off insulator at center, Type N Load break switch control above. Phenolic insulating barrier separates secondary compartment, at right, so that secondary compartment may be inspected, without danger of contact with high voltage. Available in single-phase to 167 kva; in three-phase to 500 kva

Type N Load Break Switch, an L-M exclusive; available on L-M Pad-Mount Transformers. Heavy duty mechanism with contacts operating under oil; convenient operating handle. Nominal load rating 200 amperes; 9000-amp. RMS asymmetrical momentary current rating; 4500-amp. one-second RMS symmetrical short-time current rating.

L-M Leads With Economical Equipment For Underground Distribution Systems

Designed with utility company cooperation, L-M's Pad-Mount Transformers, Transclosure housings, and other equipment provide practical aids for cutting costs of underground.

Line Material's leadership in underground equipment began years ago, with the development of a completely engineered system for underground fibre conduit. Since then, anticipating the mounting pressure for underground distribution, L-M has, over the years, developed a line of items that best met utilities' needs for practical, economical equipment.

Some of L-M's outstanding equipment:

Pad-Mount (TM) Transformers available in a variety of styles and ratings through 167-kva single-phase, 500-kva three-phase. Developed, like much of L-M's equipment, with the close cooperation of utility companies.

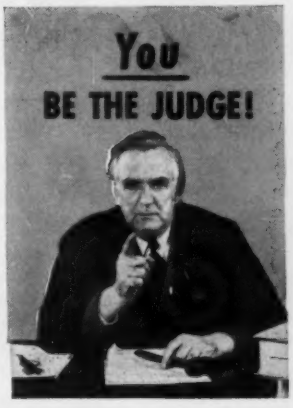
Transclosure (TM) housings available in seven sizes, for housing L-M Round-Wound® pole type transformers, switches, reclosers, control equipment for lighting systems, telephone equipment, etc. Units may be ganged. Well designed, with rainshed roof, tamper-proof ventilation, locked doors.

L-M Power Pedestal, a rainproof, tamper-proof device for terminating and connecting secondaries above ground. Designs include fusible and terminal types.

L-M Permaline Fibre Conduit and materials for all duct system requirements.

Get Complete Information

L-M Field Engineers and Apparatus Specialists can give you complete information about L-M equipment, and a good deal of helpful information about underground installations. Ask the L-M Field Engineer who calls on you; or write Line Material Industries, Milwaukee 1, Wisconsin.



LINE MATERIAL® Industries
McGRAW-EDISON COMPANY
Distribution Transformers

DISTRIBUTION TRANSFORMERS · RECLOSERS, SECTIONALIZERS AND OIL SWITCHES
FUSE CUTOUTS AND FUSE LINKS · LIGHTNING ARRESTERS · POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS · CAPACITORS · REGULATORS · OUTDOOR LIGHTING
LINE CONSTRUCTION MATERIALS · PORCELAIN INSULATORS · FIBRE PIPE AND CONDUIT

480

KILOWATTS IN THE MAKING

Checking circuits against blueprints, making final connections and testing switches, electrical workers ready a giant turbogenerator for its initial run. In plants like this United Engineers men are at home. This is the natural result of years of experience working on power projects—big and small, from coast to coast. Our power specialists have designed and constructed hydroelectric and thermal plants, electric substations, and plants for supplying heating and process steam. Whatever the project —power, process or gas plant, steel mill or industrial building—from our wealth of trained personnel we can assemble a crack team to handle it. The men who are United Engineers offer you a background of over 75 years' experience as designers, construction engineers, and engineering consultants.

Painting by Robert Lavin

Helping the power industry grow

UNITED ENGINEERS

& Constructors Inc. • U.E.&C. (Canada) Ltd. • New York • PHILADELPHIA • Chicago

NO MORE ENGINE IDLING

. . . with NEW MOTOROLA MOTRAC* 2-way radio

Idle a truck engine 4 hours a day—to regenerate for battery drain due to 2-way radio—and you waste *more than a hundred dollars* a year in gasoline alone! Add the cost of engine wear, replacement batteries, generators, etc., and you've got a significant cost leak.

But now it's *unnecessary*. Motorola MOTRAC radio uses only a trickle of current—less than a dome light—so engine idling is *out*. And that's just the *start* of MOTRAC radio savings. Truly advanced design and rugged construction give you greater *reliability*, and much longer life.

Here is truly dependable equipment for long-run economy.

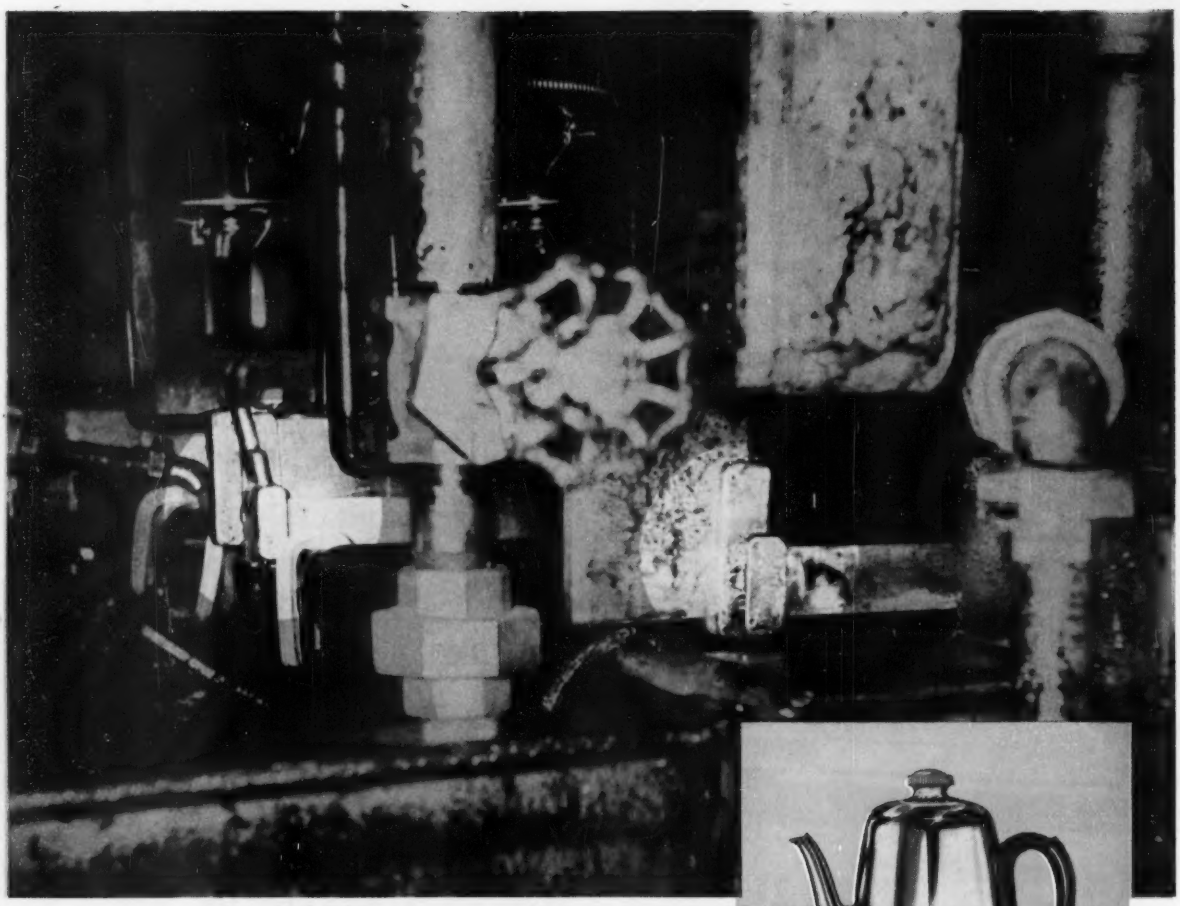
It's a big story. Get all the facts about this outstanding new radio. Call or write today.

HERE'S THE INSIDE STORY—Commonest source of maintenance problems—vibrators and receiver tubes—have been replaced by dependable transistors. MOTRAC radio can be used with any 6 or 12 volt vehicle—positive or negative ground. Models available with up to 100 watts power output.

MOTOROLA 2-WAY RADIO

Motorola Communications & Electronics, Inc., 4501 A[illegible]sta Blvd., Chicago [illegible] A Subsidiary of Motorola Inc.

*MOTRAC is a trademark of Motorola Inc.



SUNBEAM

uses CADWELD®

bus bar connections

CADWELD BUS BAR CONNECTIONS are used by SUNBEAM MANUFACTURING CORP. in chrome plating their automatic percolators because of top electrical efficiency under a severe corrosive environment and high current loads.

CADWELD CONNECTIONS are fusion welds and have no mechanical contact surfaces that can be affected by acid drippings as are bolted connections.

Illustrated in the above (unretouched) photo are the main feeder connections to the anode bars over the plating tanks.

CADWELD CONNECTIONS are ideally suited for automatic plating installations and offer maintenance-free, minimum overall cost.

CADWELD® electrical connections

Erico Products, Inc.

2070 E. 61st Place • Cleveland 3, Ohio

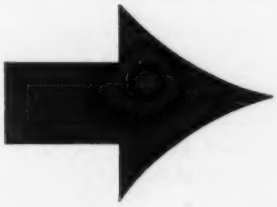
IN CANADA: ERICO INCORPORATED, 7 Superior Ave., Toronto 14, Ontario, Canada

away back in 1958

STANDARD TRANSFORMER INTRODUCED THE FIRST LOW-LOSS DISTRIBUTION TRANSFORMER

(See announcement in Electrical World, July 21, 1958 p. 96)

Have you investigated the facts which increased Standard's distribution transformer sales?



Standard Transformer CO.

WARREN, OHIO, U.S.A.

Phone:
EXpress 2-1563

"WHEREVER THERE IS POWER"

NOW STANDARD OFFERS THREE LOW-

Which One's Best For Your System?

Standard introduced the industry's first low-loss distribution transformers in 1958 because it recognized certain key differences in systems, rapidly changing industry costs, and new trends in loading practices. It was obvious NO ONE TRANSFORMER could meet the needs of ALL SYSTEMS. The best unit could be determined only by evaluating these and other key factors which vary from system to system:

PLANT INVESTMENT varies from $260 to $430 per KVA from energy source (coal, oil, gas or hydro) to primary terminals. Up 50% in 10 years!

CARRYING CHARGES on investment run between 13% to 16%.

FUEL COST ranges from 1.5 mills to 6.5 mills per KWH.

LOAD FACTOR ranges between 25% and 50%.

AMBIENT TEMPERATURES go from below Zero to 115°F. above.

These are industry averages, and the specific figures may not be true of your system. However, when you boil it all down, the best way to evaluate distribution transformers is to study the operating characteristics of YOUR OWN SYSTEM and emphasize the difference between investment and energy components. Standard can help you capitalize on your system's characteristics rather than be penalized by them. May we DISCUSS THIS CONTROVERSIAL SUBJECT with you and show you how Standard Transformers can help lower your operating costs?

WRITE for Standard's Distribution Transformer Bulletin. With it you'll RECEIVE COMPLETE PERFORMANCE DATA.

COMPARISON OF STANDARD Distribution Transformers

Conventional HV 7200 — Single Phase 60 Cy. LV 120/240

Type	SWA	WA	CWA
Approx. Price Index	107	100	96

TYPE SWA

KVA	Watts Loss No Load	Watts Loss Total 75°C.	% Impedance 75°C.	% Regulation 1.0 P.F.	% Regulation 0.8 P.F.
10	67	211	1.7	1.5	1.7
15	90	277	1.7	1.3	1.7
25	130	417	1.7	1.2	1.7
37½	172	572	2.0	1.1	1.8
50	210	715	1.9	1.0	1.7
100	400	1290	1.5	.90	1.4

TYPE WA

KVA	Watts Loss No Load	Watts Loss Total 75°C.	% Impedance 75°C.	% Regulation 1.0 P.F.	% Regulation 0.8 P.F.
10	67	248	2.3	1.9	2.3
15	90	327	2.0	1.6	2.0
25	130	498	2.1	1.5	2.1
37½	172	654	2.2	1.3	2.1
50	210	847	2.2	1.3	2.1
100	350	1522	2.2	1.2	2.1

TYPE CWA

KVA	Watts Loss No Load	Watts Loss Total 75°C.	% Impedance 75°C.	% Regulation 1.0 P.F.	% Regulation 0.8 P.F.
10	75	229	1.7	1.5	1.7
15	112	330	1.6	1.5	1.6
25	161	479	1.5	1.3	1.5
37½	215	645	1.5	1.2	1.5
50	280	840	1.4	1.1	1.4
100	480	1440	1.3	1.0	1.3

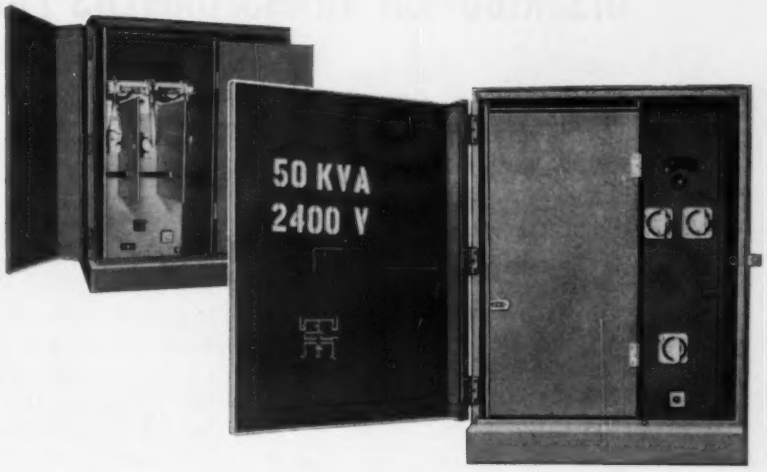
Standard Transformer CO.

WARREN, OHIO, U.S.A.

Phone: EXpress 2-1563

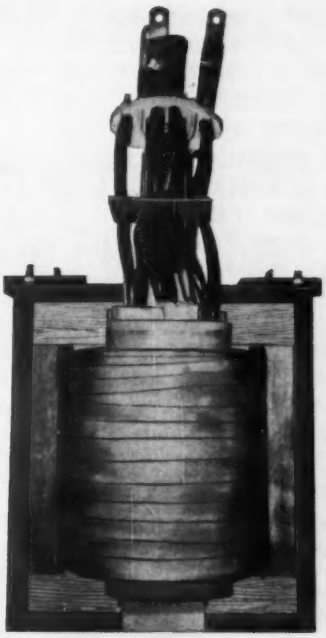
"WHEREVER THERE IS POWER"

LOSS DISTRIBUTION TRANSFORMERS



STANDARD'S FIELD-TESTED, pad-mounted units compartmental design permits changes in single phase transformers without a change of terminations. Standard termination compartments give you complete flexibility from 15 KVA through 50 KVA and 75 KVA through 167 KVA. You change the transformer only . . . just as you do on a pole.

You can work on the secondary side with perfect safety because the high voltage side is protected by an inside door. Outside door is equipped with a hasp and lock. Performance data matches that of Standard's SWA series of pole-type units. You have complete flexibility on protection and switching equipment to meet individual preference.



EXCEPTIONAL PERFORMANCE by these SWA units has placed them on the approved lists of leading utility companies. Extremely low copper losses, low impedance and low temperature rise without excessive voltage drop put these units in a class by themselves. Your Standard representative can show you how they reduce "unaccounted for" losses on your system.

GET THE FACTS ON LOSSES, OVERLOAD AND REGULATION OF DISTRIBUTION TRANSFORMERS FROM THESE MEN

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BIRMINGHAM 5, ALABAMA	J. L. Howarth, 825 South 22nd Street
BOSTON 16, MASSACHUSETTS	S. S. Morgan, 131 Clarendon Street
CEDAR RAPIDS, IOWA	C. R. White, P.O. Box 21
CHARLOTTE, NORTH CAROLINA	R. W. Chapman, 1508 E. 4th Street
CHICAGO 2, ILLINOIS	J. M. Livingston, 30 North LaSalle
CLEVELAND 14, OHIO	Richard F. Reske, 451 The Old Arcade
DALLAS 3, TEXAS	Elgin B. Robertson, Inc., 1339 Plowman Street
DENVER 2, COLORADO	Mark G. Mueller Co., 1644 Blake Street
DETROIT 28, MICHIGAN	Dale P. Seyfried, 20424 Plymouth Road
HAMDEN, CONNECTICUT	J. F. Kerrigan, P.O. Box 6016
HOUSTON, TEXAS	Elgin B. Robertson, 4101 San Jacinto Street
JACKSONVILLE 1, FLORIDA	Van and Smith, P.O. Box 5877
KANSAS CITY 8, MISSOURI	C. L. Ward Co., 3433 Roanoke Road
LOS ANGELES 13, CALIFORNIA	W. E. Kirk Co., 415 Wall Street
LOUISVILLE 17, KENTUCKY	Rietze & Co., 2209 S. Floyd Street
MIAMI 44, FLORIDA	Lee Co., 3796 W. Flagler Street
MILWAUKEE 8, WISCONSIN	M. L. Kirchmayer, P.O. Box 91
MINNEAPOLIS 4, MINNESOTA	The Klass Co., 814 S. 9th Street
NEW ORLEANS 8, LOUISIANA	Gulf Sales Agency, 3207 Metairie Avenue
NEW YORK 17, NEW YORK	G. W. Fischer, 101 Park Avenue, Room 1133
OAKLAND 12, CALIFORNIA	J. H. Ormond, 600 16th Street
OMAHA, NEBRASKA	F. C. Clatterbaugh, P.O. Box 152
PHILADELPHIA 4, PENNSYLVANIA	The Bradley Co., 3341 Arch Street
PHILADELPHIA 3, PENNSYLVANIA	Frank Lewis, 1142 Suburban Station Building
PITTSBURGH 28, PENNSYLVANIA	H. Wm. Petty, 10 Purchase Place
RICHMOND, VIRGINIA	The Bradley Co., 601 E. Franklin Street
SALT LAKE CITY 13, UTAH	A. J. Elggren, 212 W. 4th South Street
SEATTLE 4, WASHINGTON	J. C. McDougall, 520 First Avenue, South
ST. LOUIS 10, MISSOURI	Carl A. Froebel, 1246 Hampton Avenue
SYRACUSE, NEW YORK	Nellis B. Bronner, Jr., 431 East Fayette Street
TAMPA 11, FLORIDA	Van and Smith Co., P.O. Box 13103
TULSA, OKLAHOMA	Peterson Engineering, P.O. Box 4653
WASHINGTON 6, D. C.	The Bradley Co., 212 H Street

ARGENTINA, BUENOS AIRES	Lumex Soc. de Resp. LTDA, Rivadavia 1931
BRAZIL, SAO PAULA	Cia Tecnicade Industria E. Comercio, Rua Braulio Gomes 25, Con 302
CHILE, SANTIAGO	James M. Carr Y Cia. S.A.C. Casilla 2439
COSTA RICA, SAN JOSE	Francisco Font, Apartado Postal 1528
NICARAGUA, MANAGUA	Rafael Sevilla-Secasa, Avenida Roosevelt No. 505 S
PHILIPPINES, MANILA	Frank Olizon, 224 May Building
PUERTO RICO, SAN JUAN 10	Abarca Warehouses Corp., P.O. Box 2352
VENEZUELA, CARACAS	John J. Carroll, Apartado Postal 3145

Standard Transformer CO.

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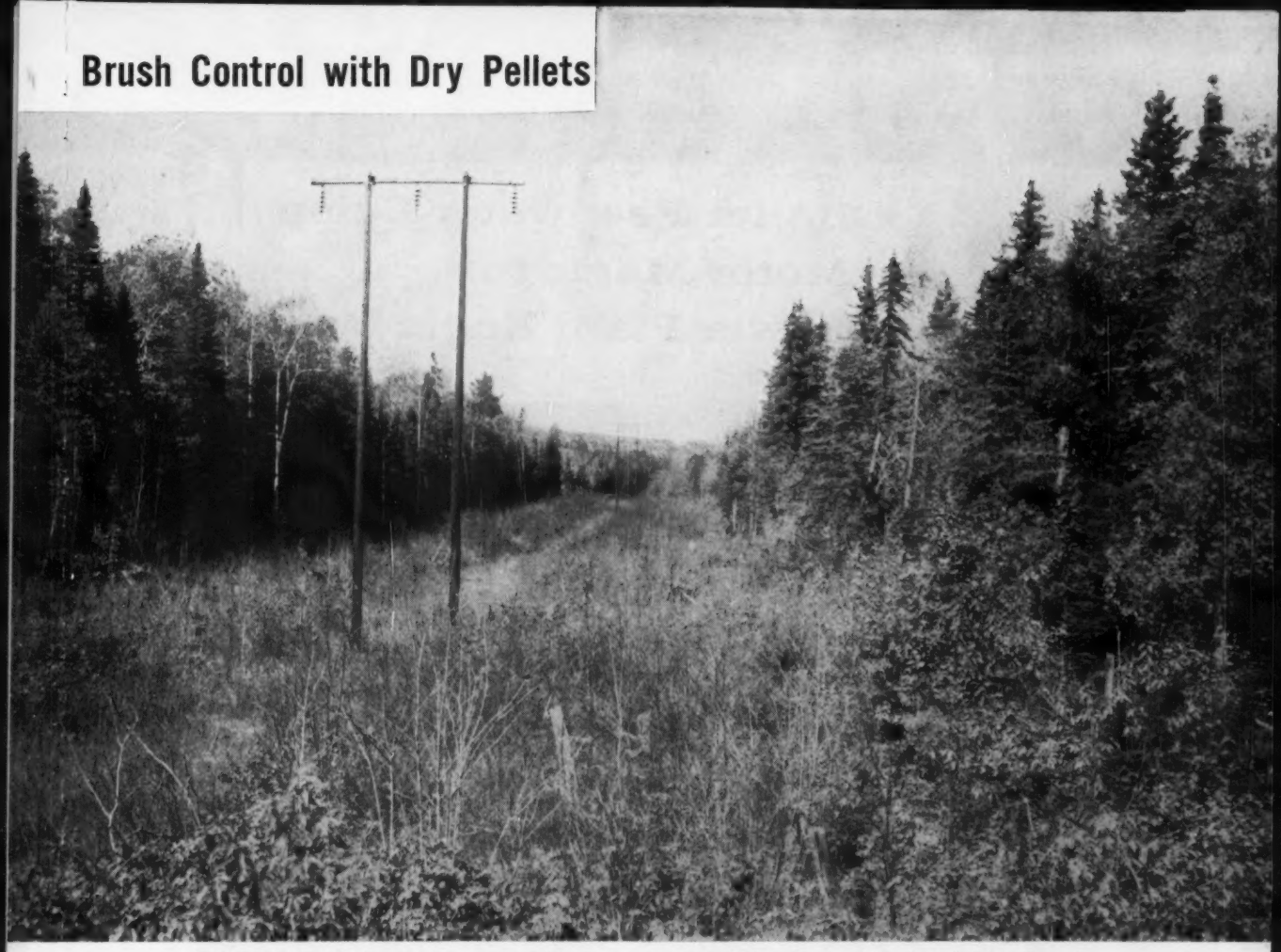
"WHEREVER THERE IS POWER"

Brush Control with Dry Pellets



This Maine Public Service Company right-of-way was cleared of conifers and hardwoods by pellets of Du Pont "Dybar"—scattered by six men walking abreast who carried the chemical in 10-lb. pails.

How Du Pont DYBAR® FENURON WEED AND BRUSH KILLER saved $13 an acre chemical cost and 50% application time for Maine Public Service Co.

"We compared dry pellets of 'Dybar' with a basal stem spray application of a hormone brush killer in oil while working on brush control for the Maine Public Service Company," says Robert N. Smith* of Gould and Smith, Inc., Presque Isle, Maine. "The brush was eight to fifteen feet high; the terrain rugged.

"Six men carrying pails of 'Dybar' applied it in an area twice as wide as that covered by a spray team of four men. The team could barely keep up with the men spreading 'Dybar'. The pellet application was twice as fast as the spraying—cleaner to work with, easier to carry and odorless. We also found it easier to keep track of the amount of chemical being applied—and no mechanical equipment and cleanup were needed.

"When we applied 'Dybar', it cost $50 per acre and $63 for the other brush killer, a saving of $13 per acre. The big saving, however, came from efficiency—the pellets going on twice as fast in comparable terrain.

"Results? We found that 50 lbs. of 'Dybar' performed as well as 100 gal. of basal spray mixture—initial kill was about equal, and 'Dybar' gave better control of conifers, as well as deciduous trees. We expect a three-year killing effect resulting in fewer misses."

Use "Dybar" in your brush control program for similar results. "Dybar" kills slowly, but surely, through the roots, yet is non-flammable, non-volatile, non-corrosive and low in toxicity to humans and animals.

Where foliage spraying of brush is desired, use "Ammate" X for maximum safety near sensitive crops. You can use "Ammate" X on rights-of-way, even when they adjoin cropland planted to vapor-sensitive crops. "Ammate" X is non-volatile, long-lasting, low in cost—low in toxicity to livestock or wildlife.

For more information, write for booklet showing results of applications of Du Pont Weed and Brush Killers. E. I. du Pont de Nemours & Co. (Inc.), Industrial and Biochemicals Dept., Room 2543-N, Wilmington 98, Delaware.

**From "Application of 'Dybar' to a Right-of-Way in Northern Maine", Northeast Weed Control Conference Proceedings—1960.*

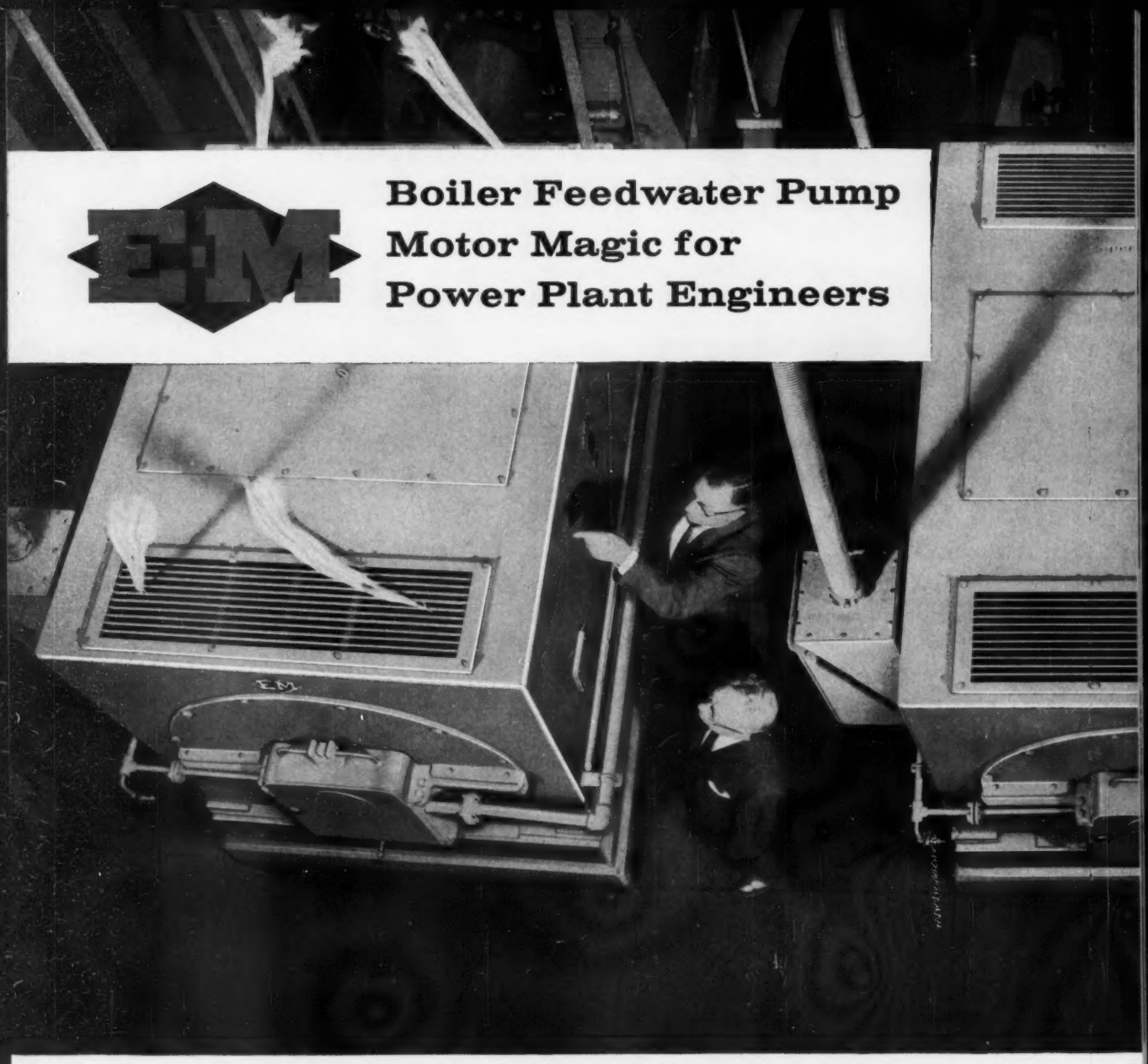
On all chemicals follow labeling instructions and warnings carefully.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

DYBAR® · AMMATE® X

fenuron weed and brush killer — weed and brush killer



Boiler Feedwater Pump Motor Magic for Power Plant Engineers

Shown above are three E-M Straight-Up-Ventilated Squirrel-Cage Induction Motors driving boiler feedwater pumps at High Bridge Station, Northern States Power Company, St. Paul, Minnesota. Each motor is rated at 2500 hp, 3600 rpm,

Straight-Up Ventilation Gives

The space-saving secret is in the natural air-flow design of E-M's Straight-Up-Ventilated Motors.

With straight-up ventilation, each motor takes in cool, clean air from both sides near floor level, circulates it in and around all operating components. The warm air is then discharged *through the top* of the motor housing. Natural convection carries it up and away where it can't heat up adjacent motors.

Thus cross-circulation and recirculation are effectively halted. Each motor has its own exclusive "convection stack" which permits compact installation with cool operation.

But that's not all. There's more magic in these E-M Motors:

GREATER OPERATOR COMFORT. No more hot blasts at face level. Since heated air from the top discharge rises straight to the ceiling, the usual warm air buildup at operator level is eliminated.

QUIET OPERATION. Aerodynamically sloped stator blowers and labyrinth air passages are among the

2300 volts. O. W. Johnson, plant superintendent, and C. H. White, assistant plant superintendent, are discussing advantages of straight-up ventilation of machine at left. Air-flow is indicated by paper streamers temporarily attached to discharge louver.

You a Compact Installation!

acoustical control features which help to minimize windage noise. The motor is not dead silent . . . just remarkably hushed.

EASY MAINTENANCE. Access panels and bearing caps are easily removed by one man without use of crane or lifting device. Permits quick inspection of coils, stator core, bearings.

And, of course, you still get the same premium materials and hand-crafted construction that has made E-M quality famous for over 60 years.

See how the magic of E-M Straight-Up-Ventilated Motors can solve *your* boiler feedwater pump power problems. Call your nearby E-M Field Engineer and write to the factory for your copy of brochure No. 1134.

ELECTRIC MACHINERY MFG. COMPANY
Minneapolis 13,
Minnesota

1300-TPA-2210

Beautiful Ohio Metropolis

Cleveland, known as the "Forest City," is the largest in Ohio and eighth largest in the United States. This financial center of Northern Ohio and industrial, transportation and agricultural hub employs more people in its metropolitan area than all the factories of 33 different states. Its industrial diversification is shown in plants of major manufacturers and moderate sized operations.

Power needs are supplied by a leading electric utility company and municipal power. Five major and three terminal railroads serve its transportation needs to weld Cleveland into the fabric of the nation. In Cleveland, as across the nation, there is a large demand for quality cable—well served by Kerite, backed by quality standards that began in 1854. *This service will continue and expand with the nation's growing needs.*

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FEBRUARY 6, 1961

Distribution Makes Ready for Tomorrow's Demands

Distribution seldom receives accolades to match those bestowed on more glamorous generation and transmission. But it serves faithfully at the mundane task of transmitting the generating plants' only product to meters which "ring up the cash" for the whole operation.

Progress in distribution design and operation is easily overlooked in the flush of excitement about a new power plant's premiere. The reasons aren't hard to find:

- Distribution is anchored at so many million points to customers' connections, and confined to public ways on so many routes, that "progress" must take other forms than those which would change the basic geography.
- Distribution plant is spread over so many thousands of square miles that the very subject is "diffuse" and the plant difficult to alter materially over short periods.
- Seldom does a brand-new distribution product break upon the utility scene with implications of immediate and wide-spread changes.

Thus progress in distribution seems agonizingly slow to those who would plot it in terms commensurate with progress in generation and transmission. And yet distribution progress continues, bucking the line on costs despite inflationary pressures and bolstering distribution's capability in the face of stiffening requirements. It stems from unceasing research for less costly, more durable components and better construction methods. Its fruits are sorely tested by sunshine, wind and storms. And much of this progress has escaped recognition, except by engineers directly associated with it.

It is to this progress—and to the stiffening requirements of the future—that this issue is dedicated. The requirements are not discussed in detail. We all know how rigorous they will be, particularly with the growing impact of air conditioning and space heating on temperature coefficients of utility demand.

But progress *is* discussed, and we have found this progress real and significant.

We do not imply here, or in the Special Report beginning on p 49 that the rate of progress is universally adequate. In some areas it probably is not. And too often the blame can be laid at the feet of utility managements who do not understand their distribution engineers and support them in their quest for progress.

The Report shows, overall, that distribution, through evolutionary development, is indeed readying itself for the future. Steps taken in relatively recent times already are showing an acceleration of distribution technology.

And there's another hopeful straw in the wind. There is indeed, that rare device, a new product that can have a wide-spread affect on distribution practice and economics: the pad-mounted distribution transformer. The Report sheds valuable light on its acceptance by utilities across the land.

And as this issue goes to press, manufacturers are bidding to release another new product which has been long awaited and which may have similar broad implications: the encapsulated distribution transformer (see p 66).

With this Report we salute the distribution engineers of this industry for their often-unsung efforts. And we invite the many who made the Report possible to accept the industry's compliments for their revealing contributions.

Senate Confirms Holum, Carr; Goldwater Hits at 'Pattern'

◀ HOLUM & CARR at hearings

Senators received a sample of the power views of sub-cabinet appointees to the Interior Dept at confirmation hearings last week. Sen Barry Goldwater (R-Ariz.) did the probing, and later criticized the 'pattern' of power appointments made by President Kennedy.

Kenneth Holum, new assistant secretary for water and power, bore the brunt of attack in hearings of the Interior Committee and in debate on the Senate floor following.

Confirmation went to Undersecretary James K. Carr, without opposition, and to Holum, who got a negative vote from Goldwater in committee, but won confirmation by unrecorded voice vote in the Senate.

Before that, though, Holum faced severe questioning from Republicans Goldwater, and Henry Dworshak, (Ida.). Dworshak explained he also was representing newly elected Sen Jack Miller, (R-Iowa).

The following give and take between Goldwater and Holum is a good example of the opposing views:

Goldwater: "Would you be in favor of federal lines being constructed to transmit non-federal power, if non-federal power meant privately developed power?"

Holum: "It is a matter of economics."

Goldwater: "Do you believe that the federal government should build lines in these areas when private utilities are willing to do it?"

Holum: "It is a matter of economics. If we can increase the return to the federal government by constructing federal transmission lines—and this is tremendously important to protect the payout of these projects—then I think the government should build them. If the economics are the other way, the situation is different."

Goldwater: "Why should taxpayers' money be used to construct facilities that private capital is willing to construct?"

Holum: "To protect the federal investment in the hydroelectric projects themselves."

Goldwater: "Where we have privately developed transmission lines today operating from federal projects, I cannot recall it ever having worked a hardship on the federal government."

Holum: "It is a matter, Senator, of what fees the private utilities want to charge for the use of their facilities."

Goldwater: "Do you believe that the federal government should build or finance steam plants to supplement power produced from federal hydro projects so that preference customers will not have to get any of their power from privately-owned electric companies?"

Holum: "I think that that is a policy decision that would be made far above my desk—by the Congress of the US."

Goldwater: "You are going to be asked about it by Secretary Udall and others above you. What is your personal feeling about the federal government investing taxpayers' moneys in steam plants to supplement power produced from federal hydro projects?"

Holum: "At the moment I am completely open-minded about it. If studies are made, the economics would determine my final decision."

Goldwater: "Do you believe that the federal government is under an obligation to meet all the power requirements of preference customers in the Missouri Basin?"

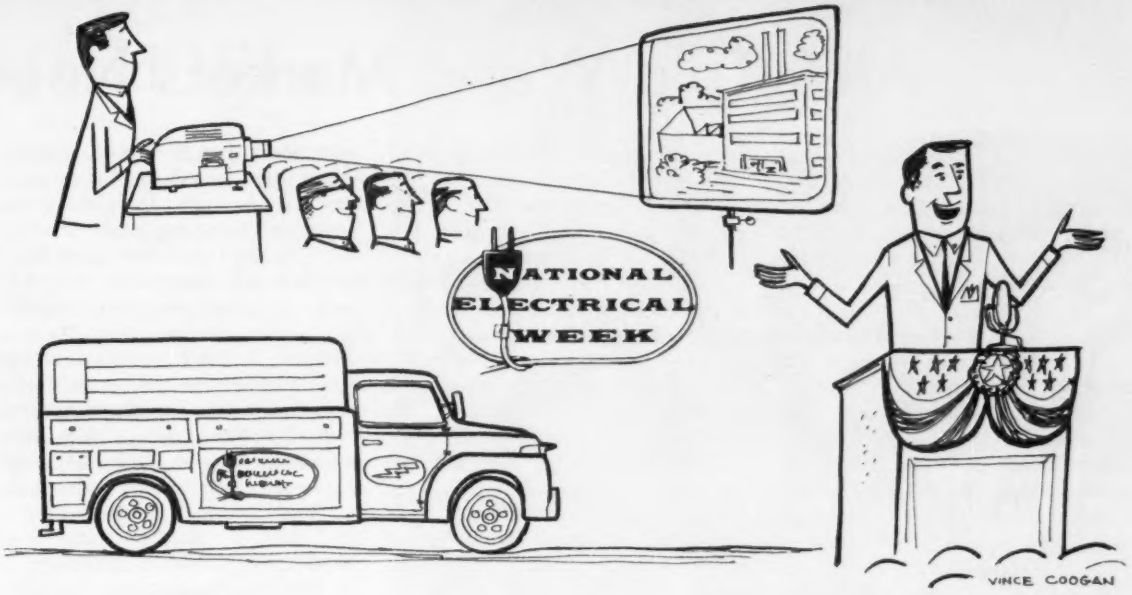
Holum: "No, sir."

Holum also said he would oppose any "TVA type" agency for the Missouri Basin.

Later, on the Senate floor, Goldwater spoke at length against the "pattern" of Kennedy appointments to various government agencies: "I rise not to speak specifically against the confirmation of the nomination of Mr Holum, but to call the attention of the Senate to the pattern which this Administration seems to be following in the appointment of men who will occupy positions of control and influence in the power field."

Goldwater, referring to Swidler who was former TVA general counsel, said "the new Administration has designated (for) a supposedly quasi-judicial body of government, an agency set up to regulate the electric utility industry—a man whose entire background is that of an advocate of government policy."

As to Morgan, Goldwater said, "I am told that during his term of office (as Oregon public utilities commissioner) he showed a very distinct prejudice against segments of the industry under his jurisdiction, in particular, the railroads and the electric companies. Frankly, I do not think there should be appointed to regulatory commissions of the government, or of any other executive agency, persons about whom there is any question of bias."



Electrical Leagues, Utilities Team Up for NEW

Local electrical leagues and associations appear to be taking over the leadership in sponsoring National Electrical Week.

The purpose of the Week which is from February 5-11 was probably best summed up by R. J. Diefenthaler, General Electric Co, and chairman of the Electrical Assn of Chicago's committee for NEW.

"The purpose of National Electrical Week is to focus attention on electricity's role in our economy and way of life, to point out its contribution to progress, and to honor those in the industry who rank as past and present pioneers," Diefenthaler said.

In the Chicago area the local celebration is being spearheaded by the electrical association.

Plans include:

- Distributing informational material to help the public gain the most benefit from their electrical investments—appliances, lighting and wiring;
- 100 talks featuring speakers from Commonwealth Edison Co, Public Service Co and the association;
- A civic luncheon with Philip Sporn, American Electric Power Co president, as headline speaker;
- Electrical inspectors will distribute wiring survey folders to homes and advise residents on proper home wiring;
- High school science classes will visit local area electrical industry plants and generating plants.

Virginia Electric & Power Co is using activities endorsed by the Public Utilities Assn of the Virginias. These activities include local sponsorship of the national essay contest, "Making Electricity Work For You," and sponsorship of an electrical trade show.

VEPCO also joined forces with the Association to run a 16-page tabloid-type supplement in last Sunday's issue of the Norfolk newspaper. This supplement contained ads of many allied firms such as banks, dealers, electrical contractors and builders, as well as articles and supplementary pictures commemorating Edison's birthday.

The annual Electric Living Exposition in Cincinnati will be the focal point of NEW in that area. Sponsored by the Cincinnati Gas & Electric Co and Cincinnati Electrical Assn, the special feature at the exhibition will be a "Man in the Moon" contest conducted by the local newspaper. Object will be to select a man to live in a plastic moon suspended over the exhibition area during the exposition.

Other plans are for an electric automobile to tour the city promoting the exposition, and special emphasis on lighting and electric heating equipment in the exposition's "Highway of Light" and "Highway of Comfort."

Special lighted signs on the city hall and utility buildings commemorating National Electrical Week, a luncheon meeting and a dinner dance will be the contributions of the Electrical League of Milwaukee to NEW.

The Electrical Service League of New Brunswick is distributing bumper stickers, holding open houses with plant tours for schools and clubs, and arranging window displays for dealer appliance sales promotions.

Rocky Mountain Electrical League has arranged for a 15-minute radio broadcast featuring Science Youth Day and dramatization of "How Electricity Works For You."

Central Illinois Public Service Co is making available to newspapers a special 60-in advertisement to be run in place of the regular CIPS ad. The offer is made only if the newspaper sells an equal amount of tie-in advertising featuring National Electrical Week.

Metropolitan Edison Co has prepared a special slide presentation showing the dramatic uses of electricity in industry for showing to civic clubs and customer groups.

The utility is going to remind customers who are eating out how much electricity does for them at home. Met Ed has distributed 150,000 NEW placemats to restaurants throughout its service area.

AIEE Told World Markets Need

World-wide markets today call for a world-wide viewpoint, the American Institute of Electrical Engineers was told January 30 at the opening of its general winter meeting in New York.

"Today, a new situation exists because of the advances not only in communications but in all branches of technology," Don G. Mitchell, president, General Telephone & Electronic Corp, told the general meeting. "The trade horizons of every country have greatly broadened, and business throughout the world sees opportunities for increased trade. Our industry and our country must not only participate but lead, or be outdistanced by competitors the world over."

Mitchell urged the industry to undertake more thorough-going programs of research and development, automation and mechanization.

"But, in addition, we must adapt our operations more effectively to both our existing and potential markets," he said. "If the market is overseas, you must meet competition by establishing manufacturing facilities overseas.

"When you bear in mind that it takes seven to ten years to translate the findings of research into a new product," he said, "you can easily see why emphasis on research has been increasing drastically in recent years. In 1941, the total spent on research was less than $1 billion annually throughout the economy. Today the annual rate is more than $14 billion and it is climbing all the time.

"We must find ways of doubling our research spending over the next few years. What we do in our laboratories today and tomorrow will determine the position of the US in the critical latter years of this new decade.

"And automation," he said, "is the key to higher volume, lower costs, greater flexibility, and higher efficiencies. When you think in terms of our exploding population, which will reach 200 million by 1970, and the steadily rising living standards, and a gross national product moving toward $750 billion by 1970, you can see why every businessman in the country will have to gear his thinking and his doing to an entirely new set of demands."

Share Productivity Benefits

In concluding his address, Mitchell sounded these specific warnings:

"If management fails to apportion the benefits of greater productivity on a fair-sharing basis among shareowners, employees, and customers; if labor takes all of the productivity increases in the form of higher wages; if government keeps increasing the tax load without making sure that it has first eliminated waste and extravagance of its present tax revenues—there won't be anything left for anybody.

"You and I and every other businessman are faced with the challenge of doing everything possible to assure a favorable business climate. I don't mean a climate favorable only to businessmen, but one that works for the benefit of everybody—the people who own businesses, who work in them, who buy from them, and everyone else.

"That is my challenge, and it is one that we will have to meet head-on if the electrical industry is to turn those wonderful opportunities of the 1960's into real progress for this country.

"We must concentrate far more on finding entirely new ways of doing things, we must be prepared to discard traditions and the 'sure thing' if we know deep down within us that there are better ways to do it. And if we don't know better ways, we simply aren't looking hard enough."

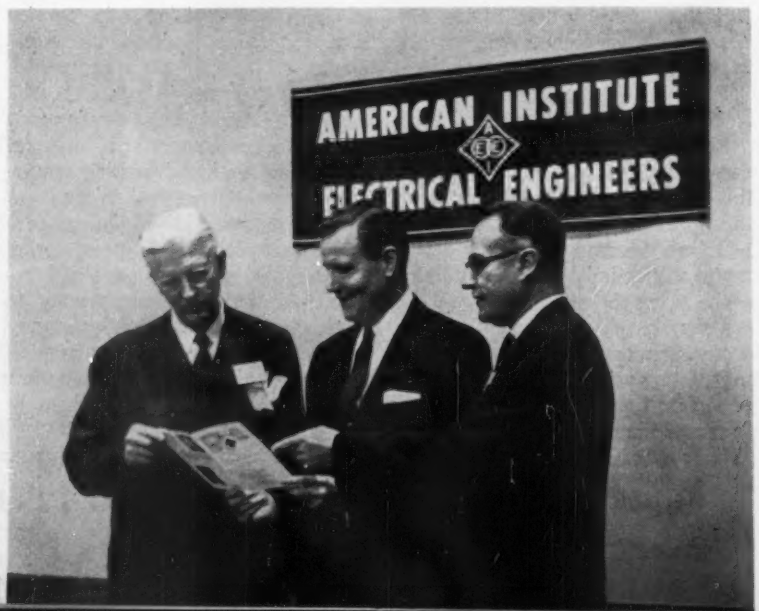
Mitchell's address launched what the meeting's general chairman, R. W. Gillette, Consolidated Edison Co, predicted would be the largest gathering of the AIEE. More than 5,000 engineers from this country, Canada, and from abroad attended the 130 sessions scheduled through February 3. Besides the meetings in the Hotel Statler, overflow groups were accommodated with meeting facilities in the Hotel Governor Clinton.

The 130 sessions and symposiums were sponsored by the six technical divisions of the world-wide engineering society, and more than 500 papers were presented on virtually all aspects of the electrical industry.

C. H. Linder, AIEE president, presided at the opening session, which in addition to Mitchell's address featured a report of the committee nominating 1961-62 officers.

Warren H. Chase, vice president, Ohio Bell Telephone Co, was nominated to succeed Linder as 1961-62 AIEE president. Vice presidents named were: Thomas E. Marburger, Baltimore Gas & Electric Co; Benjamin V. Martin, Westinghouse Electric Corp; Warren B.

LINDER, MITCHELL & GILLETTE before the opening of first AIEE session. Mitchell and Gillette were opening speakers; Linder is Institute president



World View

Boast, Iowa State University; Charles R. Day, Sacramento, Municipal Utility District; J. Prescott Skillen, Hamilton Ontario; Leslie J. Weed, Boston Edison Co; and Alva A. Johnson, Westinghouse Electric Corp.

Nominated as technical vice presidents were: Charles E. Dean, Hazeltine Research Corp, Communications Division; Lee R. Larson, Martin Co, General Applications Division; J. H. Kinghorn, American Power Service Corp, Power Division.

Directors include: Bradley Cozzens, Water & Power Department, City of Los Angeles; Walter F. Denkhaus, Bell Telephone Co; John W. Davis, Southern Bell Telephone & Telegraph Co; and, Lynn C. Holmes, Stromberg-Carlson Co.

Osborne Gets Edison Medal

At the general session, Dr Harold S. Osborne, retired chief engineer, American Telephone & Telegraph Co, was presented with the Edison Medal of the AIEE. He was cited for "his contribution to the art of telecommunication and his leadership and vision in extending its application; for his achievements in the coordination of international communication and in national and international standardization; and for his advancement of the engineering profession."

The medalist is a past president of the AIEE.

Dr Mervin J. Kelly, retired chairman of the board, Bell Telephone Laboratories, Inc., was awarded the first Mervin J. Kelly Award for his "outstanding contributions in the technology of telecommunication; as a distinguished organizer and an eminent leader."

Winners of prize awards for papers read at the winter general sessions were: Bern Dibner, Burndy Corp; James E. Hogan and John W. Horine, Pennsylvania Railroad Co; Bernard Husock, Harco Corp; Solon C. Bartlett, American Electric Power Service Corp; George W. Dick, Bell Telephone Labs; and David F. Moyer, consultant; G. Douglas Talbott Md; Richard A. Elco, Carnegie Institute of Technology; and, Reed M. Gardner, University of Utah. The last two are students.

In his address of acceptance of the Edison Medal, Osborne declared that engineering leaders today must "crystalize a clear statement" of the goals of unity of the profession.

"Might not additional progress be made if the leaders of the profession who are working on the problem of increased unity would undertake jointly to crystallize a clear statement of the purposes for which the profession should aim in deciding upon its future organization?"

He urged that these leaders in their deliberations "fully take into account the explosive character of our era, technically and socially."

EDISON MEDAL went to H. S. Osborne, right, in ceremony featuring C. M. Mapes, left, chairman of the Edison Medal committee, and H. I. Romnes, Western Electric

Business Drop Saps Winter Peaks

Company	1960 Winter Peak Load Mw	Increase Over 1959 Winter Peak Mw	Increase Over 1959 Winter Peak %	% Over Predicted Winter Peak	% Over 1960 Summer Peak
Alabama Power Co	1,738.5	166.2	10.6	1.5*	− 8.5
Allegheny Power System	1,767	−26	−1.5	− 4.0	9.6
American Electric Power Corp	4,877.5	147	3.1	− 2.5	6.6
Arizona Public Service Co	427.6	72.8	20.5	.....	.....
Arkansas Power & Light Co	730	74	11.3	.....	−22
Atlantic City Electric Co	1,311.5	15.9	5.4	.....	.....
Baltimore Gas & Electric Co	965	41	4.4	− 4.3	− 6.5
Boston Edison Co	991	21.2	2.2	− 4.4	9.3
California Electric Power Co	325.8	25.4	8.5	− 2.2	−12.2
Carolina Power & Light Co	1,266	120	10.5	− 0.6	2.3
Central Hudson Gas & Electric Corp	240.9	12.7	5.6	− 6.2	6
Central Maine Power Co	398.8	7	1.8	− 6	6
Central Vermont Public Service Corp	118.8	3.6	3.1	− 3.8	14.4
City of Seattle, Dept of Lighting	889	19	2.2	− 4.1*	.....
Cleveland Electric Illuminating Co	1,383	−69	−4.8	−11.3	− 2.9
Commonwealth Edison Co	4,479	181	4.2	0.2	2.4
Connecticut Light & Power Co	755.1	23.6	3.2	− 5.9	16.9
Consolidated Edison Co of N. Y., Inc	4,071	139	3.5	− 0.7	− 6.5
Consumers Power Co	1,876.4	34.5	1.9	− 4.3*	8.6
Delaware Power & Light Co	398.5	14.7	3.8	− 4.7	− 8.6
Detroit Edison Co	2,798	64	2.3	− 3.2	5.6
Duke Power Co	2,642.2	164.3	6.6	− 1.2*	− 0.7
Duquesne Light Co	1,125.8	−62.3	−5.2	− 3.8	− 1
EEI—OVEC	2,688	.....	....	.....	.....
Florida Power & Light Co	1,652	113	7.3	− 6.0*	22
Florida Power Corp	756	94	14.2	5.0*	35.5
General Public Utilities	1,981.2	30	1.5	− 4.2	3.9
Georgia Power Co	2,327.8	195.1	9.1	− 1.6*	− 5.0
Hartford Electric Light Co	362.6	7	2.0	− 3.6	−38.1
Houston Lighting & Power Co	1,255.7	49.8	4.1	− 6.3	−35.5
Idaho Power Co	527	38	7.2	1.3	−14.2
Indianapolis Power & Light Co	549	11	2	−11.5*	− 7.6
Iowa Power & Light Co	288.3	18	6.7	− 0.2	−10.5
Kansas City Power & Light Co	538	26	5.1	− 3.4	−26
Kansas Gas & Electric Co	405.7	20.8	5.4	− 1.0	−22.2
Long Island Lighting Co	1,034.1	83.9	8.8	− 5.1	18.4
Los Angeles Dept of Water & Power	1,600	70	4.6	− 3.3	8
Louisiana Power & Light Co	403	34	9.2	1.3	−25.6
Mississippi Power & Light Co	362	8	2.3	.....	−25
Mississippi Power Co	238.1	23.5	11	− 2.0	−27.4
Montana Power Co	557	50	9.9	.....*	15
New England Electric System	1,453	15	1	0.4	15.2
New Orleans Public Service Co	250	7	3	− 1.6	−42.5
New York State Electric & Gas Corp	801	4.6	0.6	− 6.0	16.2
Niagara Mohawk Power Corp	2,919	−26	−0.9	− 4.5	12.5
Northern States Power Co	1,508	131.1	9.5	0.1	7.3
Ohio Edison System	1,685.6	−29.9	−1.7	.....*	4.4
Oklahoma Gas & Electric Co	591	55.1	10.3	0.7	−30.2
Pacific Gas & Electric Co	4,755	131.3	2.8	− 7.3*	− 7.3
Pacific Power & Light Co	1,050	11.7	1.1	− 4.1*	25.4
Pennsylvania Power & Light Co	1,358	−16	−1.2	− 5.7	− 1.2
Philadelphia Electric Co	2,479	31	1.3	− 5.4	− 5.7
Portland General Electric Co	924	5	0.5	− 4.1*	32.5
Potomac Electric Power Co	855	37	4.5	− 2.3	−28.5
Public Service Co of Colorado	720	75.8	11.8	0	13.1
Public Service Co of New Hampshire	326.3	19	6.2	− 2.6	9.8
Public Service Co of New Mexico	201.6	21.6	12	− 5.4	1.6
Public Service Electric & Gas Co	2,586	66	2.6	− 4.6	− 7.6
Puget Sound Power & Light Co	693	22.9	3.4	− 7.4*	37
South Carolina Electric & Gas Co	606	41	8.0	− 1.8	− 0.7
Southern California Edison Co	3,402	221	6.9	− 2.2	− 0.9
Southwestern Public Service Co	640.4	57.8	9.9	0.4	−16.4
Tennessee Valley Authority	10,302	661	6.9	− 0.9*	31
Union Electric Co	1,554	71	4.8	− 1.4	−16.5
Utah Power & Light Co	665.3	36	5.7	− 3.6	0.6
Virginia Electric & Power Co	1,759	205	13.2	2.3	− 0.7
Washington Water Power Co	582	−70	−10.7	−12.9*	21.8
Western Massachusetts Electric Co	307.2	46.5	17.9	0.1	21.8
Wisconsin Electric Power Co	1,160.5	4	0.3	− 5.0	0.1
	98,235.3	3,830.6	....	.....	.....

* Seasonal peak after Dec. 31 last year

Unsteady business conditions and erratic weather took most of the punch out of anticipated winter peak gains for a large chunk of the nations utilities, according to *Electrical World's* annual winter peak survey. Thus reports from 69 utilities (of the 70 surveyed) representing over 98,000 Mw peak, showed a gain of only 3,800 Mw over 1959's peak, in contrast to a 4,700-Mw gain from the previous (1958) survey. Only 12 of the 62 companies reporting winter peak estimates hit or passed the mark. The other 50 fell short. The tabulation at the left shows some of the individual results.

In most cases, the villain was the slowdown in industrial activity and the accompanying let-up in commercial business. Consequently, it was the utilities in the Great Lakes-Northeastern industrial belt who suffered the most. But the effects spilled over into neighboring regions. And regional strikes put a crimp in utility growth in other areas. In all, 21 of the 69 reporting utilities cited poor business conditions as a significant factor in the peak growth lull.

Heavy Snow Proves Drawback

Weather, as usual, played a big part in the results, but not always in a predictable way. In many areas, mild, unseasonable weather held down heating loads and trimmed the top of the peak demand. But other utilities which had worse than usual weather were hit, too. For example, heavy December storms that covered much of the Northeast with 10 to 15 inches of snow and tied up all transit, caused many industrial and commercial companies to close up and send employees home. The results showed up on utility meters.

An apparent trend in the timing of winter peaks may also have been a factor. In its current form, *Electrical World's* survey covers only the period ending Dec. 31, 1960. Last year, 16 of the reporting companies hit their highest peak in the early months of 1960, after the survey was completed. Twelve of the utilities (indicated by asterisks on the table) who are still below

peak estimates for this season are in this group. And in this year's survey, three other utilities, Idaho Power Co, Utah Power & Light Co, and Los Angeles Dept of Water & Power, reported anticipations of higher peaks later in 1961. Together, the two groups included all but three of the reporting utilities in the western most quarter of the country. Moreover, the extreme cold that hit much of the US last month, pushing kwhr use to a new 15.3 billion kwhr record (see chart, p 14) probably set new peak loads for many utilities.

The calendar was cited as a brake by several utilities. With Christmas falling on Sunday and many companies taking Monday as a holiday, the normal peak was more dispersed, they claimed, and never hit expected heights.

Of the utilities reporting, 14 hit winter peaks on Dec. 21, 13 on Dec. 22, six on Dec. 20, and six on Dec. 19. In all, more than 56% of the survey peaked in this 4-day period, including almost all the Deep South companies, many of the Midwestern companies, and a segment of the Middle Atlantic. A good part of New England, the Middle Atlantic, and the Upper South made high water marks in the Dec. 12 and 13 period, with three companies on the first day and nine on the second. Only five companies peaked after Christmas. Of the remaining companies, four peaked in the first seven days of December, five in November, and two companies, both in the West, in October. Most of the early peaking companies were in the West and South.

Poor business and weather distorted some of the normal summer-winter relationships, too. Four companies, who normally have winter peaks, made their high for 1960 in the summer months. Included were Duquesne Light, Pennsylvania Power & Light, Duke Power, and Southern California Edison. For the California utility, it was the first time in 10 years that annual peak was not in December. One other utility, Carolina P&L reported a trend toward a summer peak.

Typical of the local conditions affecting some of the utilities was seven-month strike among mining customers of Washington Water Power whose peaks for summer and winter were both reduced.

Kerr Report Urges More Federal Action on Water Resources

Sees water use for pollution control overriding power needs, and possible shortages in five areas by 1980

Hydro-electric and steam plant generation are top users of water in the United States today, and will continue to be through the year 2,000. That is estimate of the long-awaited report of the Senate special committee on water reseources released by Sen Robert S. Kerr, D, Okla.

The report sees a future for conventional generation with little competition for nuclear power.

With better conservation, the report says, there will be sufficient water through the years for all uses. And Kerr says the federal government should take a greater hand in marshaling the nation's rivers and reservoirs for all kinds of development.

The report specifically does not join the issue of investor-owned company vs. public development of electricity. Rather, the committee of 12 Democrats and five Republicans foresees some 200-billion worth of water development by both private and public effort in the decades ahead.

The report points out that hydro-electric generation is followed by irrigation use as of today; but that pollution dilution will go into second place by the year 2,000, with steam generation third.

The committee brushes past hydro-electric generally, principally because this doesn't divert water from stream beds or consumed it in use. Although no mention was made of federal, public or investor-owned power development.

With the degree of river regulation that will be needed to provide for the nation's water needs in 1980 and 2000, there will be many opportunities for development of hydro-electric power," the committee says, "as there are alternate sources of producing electric power." However, the "quantity of water needed for pollution abatement is assumed to be controlling" over power needs.

The committee continues: "Within the present limits of our ability to foresee the future, there is no reason to expect that the value of hydro-electric power generation will be decreased by any future trend toward steam-electric generation by nuclear-powered plants. On the contrary, it appears that as larger nuclear reactors are developed, they will be most useful in carry base loads, and hydro-electric generation will be even more valuable than it is today for carrying peak loads."

Here are the committee's five recommendations:

- The federal government, cooperating with the states, should prepare and maintain comprehensive development and management plans for all major river basings. These plans should include prospective water demands, and also should include all non-revenue-producing purposes. Projects requiring Congressional authorization should be related to these plans. The President should be requested, by January, 1962, to submit to Congress his program for completing studies by 1970.
- The federal government, cooperating with the states, should "encourage" efficient water use and development through: flood plan regulation, immediate studies of regions where water shortages will be most acute by 1980, studies of needs for major reservoirs, provision for public hearings near proposed federal water projects so that state, local and business interests can participate and comment.
- Washington should set up a 10-year program of financial aid to states for development of comprehensive water plans—$5 million yearly during the coming decade.
- The federal government should set up a coordinated scientific water research program, and the President should submit such research plans to Congress by January, 1962, so that federal funds needed to maintain such research could be provided in the budget for fiscal 1963.

(*More details in Feb. 13 issue*)

News Scope

HOT OFF THE PRESS—Edison Electric Institute's 1960 Pocketbook of Electric Industry Statistics has just been published. This eighth edition contains new tabulations on condensed combined income statements and a condensed combined balance sheet for investor-owned electric utilities.

CO-OPS UPHELD—Rural electric cooperatives may continue to serve portions of their territory taken into municipalities, North Carolina Supreme Court has ruled in two cases. The court stated that the utilities' service area did not alter with the change—but they may not take on new members in such areas.

EXEMPTION — Municipally-owned utilities are now exempt from Wyoming Public Service Commission regulation. A bill passed by the Wyoming House, 46-8, counters a state Supreme Court ruling two years ago which said PSC has the authority to regulate rates charged by municipals.

Dateline . . . Washington, D. C. (*Continued from page 5*)

asked for return of the back-up data only, and not the earlier recommendation that was based on it, **(2)** He wouldn't say whether the data would be withdrawn for revision, or for complete reversal, or permanently dropped, **(3)** There was some legal and practical question of whether the Department's earlier recommendation, and the subsequent back-up data—now in the hands of many parties to the FPC hearing—could effectively or unilaterally be withdrawn.

The practicality of blotting out the old estimate is virtually impossible, because copies of it were sent to all parties in the FPC hearings. Udall didn't ask for any of these copies back, however—only from the FPC.

Legally, the old estimate is dead. It hadn't been placed on the record when Udall requested its return —only distributed for information. The estimate was to have been put on the record when Bonneville's commercial operations officer, Bernard Goldhammer, took the stand to justify it in cross-examination. Goldhammer won't be called now until, or unless a new estimate is prepared. And a new estimate may not be prepared in time for submission into the present hearings.

The Department's original recommendation against either project also is dead, unless a new estimate is submitted to back it up. Without such new estimate, the original recommendation, filed in December and on the record, will have no weight.

Bonneville's first estimate had been drawn up to show the power capacity available in the Northwest with the addition of Canadian power development. Understandably, the Eisenhower Administration wanted to show off its proposed treaty with Canada in as good a light as possible. And the original Bonneville estimate—showing an annual power surplus—was a good way of doing this.

Critics of the estimate, however, claim the estimate may have erred in: **(1)** The amount of steam generating capacity included as base capacity, instead of as reserve, **(2)** Failure to include adequate interruptible loads, **(3)** Failure to anticipate any load increases beyond those already under contract.

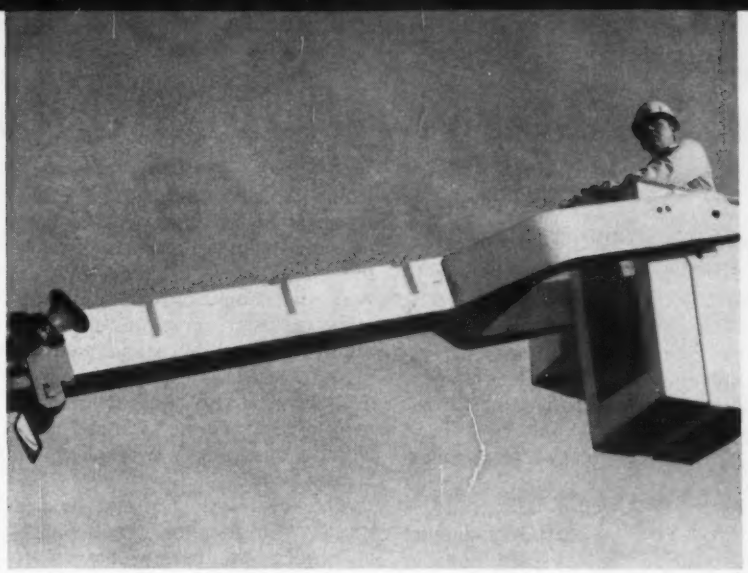
These criticisms were certain to be raised if Goldhammer had been called to justify the original estimate.

But the new Interior hierarchy faced policy problems, in addition to any mathematical errors, in the original estimate. How could a federal Bonneville-California intertie, or a federal Bonneville-Missouri Basin intertie be justified in the face of small annual surpluses on the Bonneville system?

Any estimate, such as the original Bonneville one, which tended to reduce the development of new capacity in the Northwest, could affect the feasibility of the California-Bonneville line. The small annual surplus indicated in the Bonneville estimate would suggest that the area needed no power from California, and also might not have enough to export on an economic basis. Interior Undersecretary James K. Carr, a leading force behind California's water and power development, certainly has an interest in this.

Also, the Midwest Electric Consumers Assn., which wants a Bonneville-Missouri Basin tie sometime after 1975, would hope to see exportable blocks of power developed in the Northwest. Assistant Interior Secretary (Water & Power) Kenneth Holum was executive secretary of this group until he was nominated to his present post.

Directly related to the FPC hearings, the old Bonneville estimate—that Bonneville already had adequate prime power—would affect the Nez Perce application, more than to the High Mountain Sheep because: **(1)** all of Nez Perce's power would be fed into the Bonneville system over federal transmission lines, while part of High Mountain Sheep's power would go outside the Bonneville area to Montana, and to non-preference customers, **(2)** Nez Perce would develop a larger block of power than High Mountain Sheep, making Nez Perce's capacity more vulnerable to market problems (the equalizing block of power in the High Mountain Sheep plan would be built later at the Lower Canyon site, providing a greater degree of market flexibility).



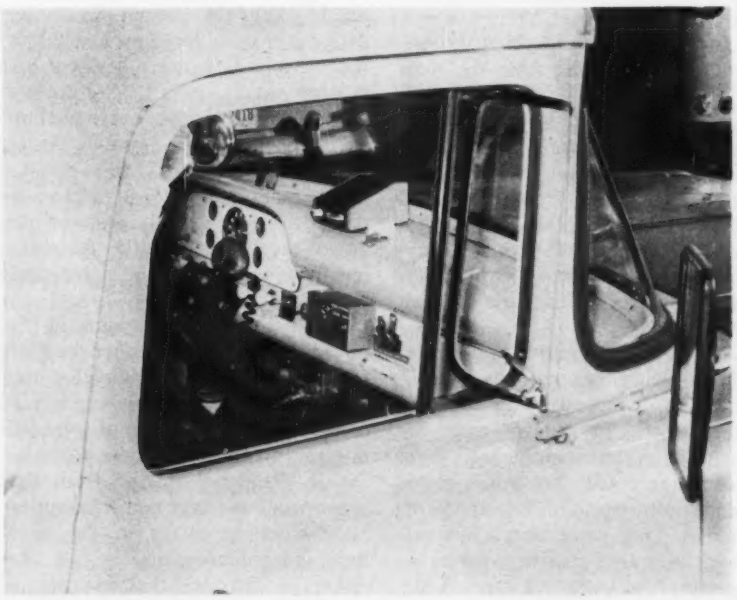
TWO-SPEAKER INTERCOM system coordinates activities of truck driver and man in bucket—two-way conversation increases crew's efficiency

Intercom Speeds Bucket-Truck Work

R. C. WEBB, Operations Supt, Florida Power & Light Co, Miami, Fla.

A sensitive, transistorized intercom system on bucket trucks of the Miami Trouble Section of Florida Power & Light Co facilitates communications between the man in the bucket and the driver in the cab. Furthermore, the system is particularly unique in that it provides excellent two-way communication between the man in the bucket and the driver in the cab without compromising the insulating qualities of the fiberglas upper arm and basket. The intercom equipment is mounted in the cab, with an outdoor speaker mounted on the high end of the lower (metal) boom section, facing the bucket operator. The sensitivity of the intercom is sufficient to provide excellent two-way communication even when the bucket operator is working at the maximum extended position of fiberglas upper arm and basket.

During the day, a two-man crew uses the vehicle on group replacement of street lamps. At night this truck is used on trouble work by a single troubleman. By means of a switch in the cab, the troubleman can use the intercom system in monitoring radio calls while he is working aloft in the bucket.



INTERCOM IN CAB can be switched on to monitor radio calls while lone troubleman works aloft in bucket

Microwave Relaying for 230-Kv

Stability requirements compel use of 3-cycle breakers; 6,700-Mc microwave system minimizes fading problems

E. F. MITCHELL, Junior Engineer,
W. W. VALENTINE, Senior System Protection Engineer, Potomac Electric Power Co, Washington, D. C.

High-speed tripping and extreme attention to system reliability are features of a microwave relaying system installed by Potomac Electric Power Co to protect its 230-kv transmission system.

The 230-kv system connects PEPCo's Dickerson Station to an existing tie line to Baltimore, and it will ultimately develop into a half-ring around the operating territory.

This arrangement requires that many of the circuits have three terminals, and, because the step-down transformers do not have high-side breakers, some form of remotely-actuated tripping is needed to protect the transformers. In addition, stability studies indicated that faulted circuits must be tripped within 6, 8, 12 and 19 cycles for 3-phase, 2-line-to-ground, 2-line, and single-line-to-ground faults, respectively. These requirements compelled the use of 3-cycle breakers.

A 6,700-Mc microwave system was selected. In picking this instead of 2,000-Mc, consideration was given the problem of fading. It is generally agreed that total fade duration time for the two systems is about equal. Fading for 2,000-Mc is infrequent, but it is of relatively long duration when it occurs. Fading for 6,700-Mc occurs fairly frequently, but each fade is of extremely short duration.

For relaying, the risk of frequent short-duration fades momentarily delaying a tripping signal is preferred to the risk of a relay operation called for during a longer blackout. Also, 6,700-Mc offers simpler circuitry, independence of transmitters and receivers, and is more adaptable to reflector-antenna arrangements where the reflector is tower-mounted remote from the switchyard.

R. F. path and system reliability problems were studied carefully. This directed attention to path fade margin and base band signal-to-noise ratio, tower and antenna system reliability, R. F. equipment reliability and changeover provisions, and power supply.

Specifications called for a minimum of 35 db fade margin in each path. The signal-to-noise ratio is 45 db flat on the worst 3-kc channel with all channels loaded and no fades, with a minimum signal-to-noise ratio of 25 db flat on the worst 3-kv channel during a 35-db fade. This insures subchannel operation down through a fade until the R. F. channel is lost, and it prevents cross-channel interference.

Towers Must Be Sturdy

Microwave towers and antennas must still be standing and operative after power lines and/or towers are down under icing or hurricane wind conditions. Requirements specified that all towers should be self-supporting and designed so that no member of the tower would be stressed beyond the maximum loading specified in RETMA Standard TR-116 with ½ in. of radial ice and a horizontal wind pressure on the entire structure of 30 psf from the most severe angle, as measured on a flat surface.

In addition, under 20 psf horizontal wind loading from the most severe angle with no ice, the maximum deflection of the antenna system from the no-wind position can cause no more than 5 db loss of signal transmitted from the R. F. equipment to a remote receiver because of beam deflection. These conditions are for an ultimate of three antennas or reflectors on each tower.

All R. F. transmitting and receiving equipment is provided in duplicate with changeover and alarming equipment. If outage time for warm-up of cold standby equipment can be accepted, previously-tested cold standby equipment seems to offer reasonable protection. However, when failure of one transmitter or receiver forces the transfer of the whole repeater station, two transmitters and two receivers, to four new cold standby units because of the single failure, the odds that all four units on cold standby will warm up and come on operating are not good. If hot standby equipment is used and no alarming is available, the chances that four unmonitored or alarmed standby units will be operating when called for appear poor also.

The ideal system would be hot standby with monitoring and alarming of all operating as well as standby units with complete flexibility in replacement of a single defective transmitter or receiver with its standby counterpart. But the transfer scheme to accomplish this is so complex as to be itself a source of trouble.

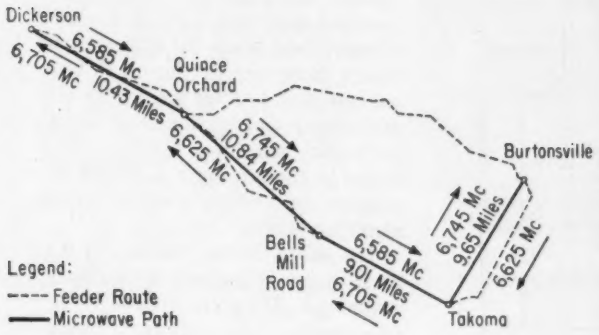
Hot standby was selected, and complete alarming of the standby unit is provided together with complete sensing for changeover of the active unit. If a transmitter or receiver fails in the "east" direction, the "east" standby transmitter-receiver combination comes on. The normal "west" equipment continues to function, retaining its standby equipment in reserve.

Remote receiver equipment is not changed over upon loss of transmitted signal, because on loss of signal a pre-changeover condition is set up whereby the receiver alternately senses the normal signal and a signal from a local oscillator. If the receiver can sense the local oscillator signal, it is not defective and does not change over, waiting for restoration of normal signal from changeover of the remote transmitter. If the local receiver is defective, it will not respond to either the normal or the alternate locally-generated sensing signal, and changeover is initiated.

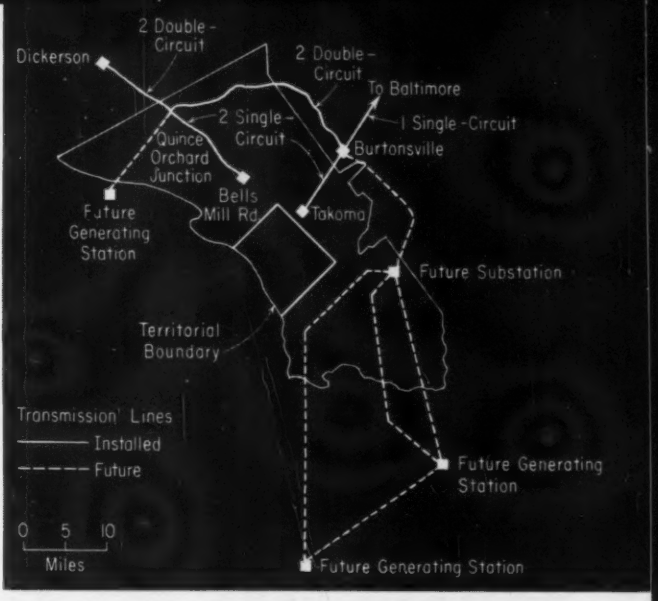
The changeover equipment is duo-directional, and either bay of equipment can be standby for the other bay. The changeover is accomplished by operation of solenoid plungers in the waveguides to route the R. F. signal to and from the appropriate receiver and transmitter and switching relays in the base band video connection.

Unlike carrier, the microwave

Stresses Reliability



MICROWAVE PATH does not follow power line routes but was dictated by the terrain and line-of-sight requirements



THE 230-KV SYSTEM will eventually be extended to provide a ring around the system, connecting with power plants

system has power furnished at all terminals by a three-unit engine-motor-generator set with a two-unit engine-generator set in reserve. The three-unit set is continuously operated from the normal station service supply. There is an electrically held-open clutch between the m-g set shaft and the gas engine.

If the system suffers a severe or prolonged voltage dip, or station service supply power is lost, the electric clutch engages, cranking the propane-fuel gas engine. The reserve engine-generator is on a dead standby basis. It will come into action after a time delay for any failure of normal generator set output power.

Primary protection is provided by directional distance relays for both phase and ground faults. Westinghouse Type HZ relays are used for phase protection because of the fast operation of the balanced-beam type of relay and the stringent speed requirements of tripping for stability on multi-phase faults. General Electric Type GCX17G relays are used for ground protection.

These relays are provided at all terminals and operation is uniform on the system. Zone one is short of the line section but long enough to reach the junction of three-terminal lines. Zone one contact closure initiates local tripping and causes a frequency shift on the microwave channel from guard to trip. This trip signal initiates instantaneous tripping of the remote line terminal.

Because of limits on the second zone, it can not achieve 100% coverage of the immediate line section for all conditions of three-terminal operation. Zone three contact closure initiates time-delayed tripping in the usual manner, but it also instantaneously sends a microwave relay channel signal referred to as a permissive trip. This is also a frequency-shift signal and is the opposite of a carrier blocking signal.

Receipt of this signal from both remote terminals of a three-terminal line permits local zone two contacts to start instantaneous tripping. If one or more remote permissive trip signals is missing, zone two tripping is time-delayed in the usual carrier blocking method.

High-Speed Reclosing Considered

Separate frequency-shift relay channels are provided for phase relays and ground relays in both zone one direct-trip and zone two permissive-trip systems, because high-speed reclosing is being considered. Because of the difference in stability time limits between multiple-phase faults and ground faults, it was felt that high-speed reclosing should be evaluated. Future problems which could occur with high-speed reclosing would be reduced if phase and ground relay controls were separated.

Differential protection of the direct-connected transformers was accomplished by having the differential relays initiate still another frequency-shift relay channel which will cause tripping of the breakers at the remote terminals.

The map above shows the system presently protected. Auxiliary signalling services are provided over the microwave system as follows:

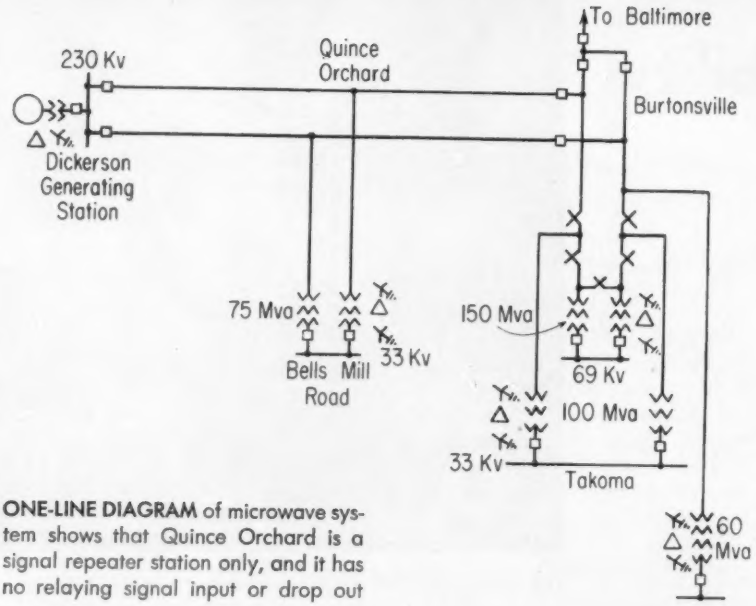
1. Remote supervision and control of both Bells Mill Road and Burtonsville Substations are provided from Takoma Substation.

2. Three telephone voice channels are provided from Dickerson Station via microwave to Takoma and then over leased lines to PEPCo's headquarters in downtown Washington. Dickerson plant kw is sent in the same manner, and net Baltimore-Washington System interchange is telemetered back to Dickerson.

3. Telemetering of the Burtonsville interchange kw is transmitted to Takoma via the microwave system.

Quince Orchard has a signal repeater station only, with no relaying signal input or drop out. Also, the dogleg routing of the microwave path does not follow power line routes. Both of these conditions arose because of line-of-sight requirements and rolling terrain.

About 3½ miles from Dickerson a high ridge produces a pivot point which caused a magnified requirement for tower heights at either Quince Orchard or Bells Mill Road. The path from Dickerson to Bells Mill Road would have resulted in an impractical tower height at Bells



ONE-LINE DIAGRAM of microwave system shows that Quince Orchard is a signal repeater station only, and it has no relaying signal input or drop out

Mill Road so the repeater station was placed at Quince Orchard. Quince Orchard will eventually become a switching point requiring relay channel drops, so the equipment is a good initial investment.

The portion of the microwave baseband from 300 cycles to 3 kc is allocated to the order wire, which is a communication channel linking each of the five microwave stations. It is equipped with a telephone handset and a push-to-ring call system. This equipment furnishes a simultaneous five-way voice channel used extensively for both maintenance and general system service and coordination.

Next in the frequency spectrum, 5.5 to 14.5 kc, are ten possible alarm channels, of which only four are used at present. Each channel consists of a transmitter that sends a five-character dot-dash code when actuated by contact closing alarm devices. The position of the dash denotes the alarm function.

Only alarms important enough to warrant immediate attention and directly affecting the microwave were included on this system—R. F. bay switchover, loss of station service, loss of relaying receivers, and receiver operation at trip frequency. In the case of Quince Orchard, tower top and side lights were included, because there is no supervisory equipment there that could be used for alarm indication. Takoma Station is attended, and alarms are brought to the station annunciator system.

The master alarm detector is also located at Takoma. This rack-mounted unit monitors each alarm channel, and when an alarm is received from any of the other four stations, the detector sounds an audible alarm and lights a lamp designating the station in trouble. The operator then pushes a button to produce the audible code, which is identified from a check list.

The 40 to 200-kc portion of the baseband is allocated to relaying channels. They are spaced 4 kc apart with a 1-kc shift from guard to trip frequency. The relaying transmitter normally sends a guard signal and will transmit a trip if an external set of protective relay contacts closes. The signal is injected onto the baseband and may be received at any station with a receiver at that frequency.

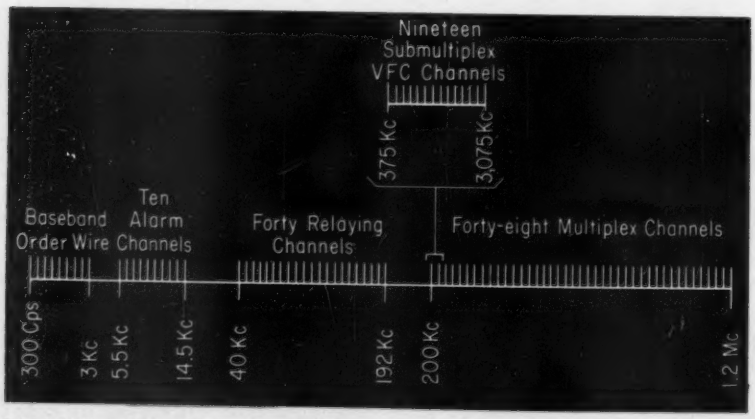
The receiver output relay is a Sigma 72RO, SPDT, spring loaded to the guard position for safety. A condition of noise, loss of receiver power, etc., will cause it to remain in the guard position by shorting the coil, while a separate alarm relay de-energizes and closes a set of alarm contacts.

28 Relaying Channels Used

At present there are 28 relaying channels linking Dickerson-Bells Mill Road-Burtonsville for protection of the two 3-terminal lines and 18 channels linking Burtonsville-Takoma for that pair of lines.

Initially, separate channels were provided for each trip function, such as Zone 1 phase trip, Zone 1 ground trip, transformer trip, etc., thus effectively having each set of receiver trip contacts paralleled and in series with the master tripping relay. However, operation disclosed that even with all protective measures taken, it was still possible under certain very abnormal conditions for interharmodulation of false frequencies to cause any one receiver to flash into trip position, clearing the line.

To prevent false tripping four separate channels were provided for each transfer trip function. On the receiving end, trip contacts were combined into two parallel circuits of two series contacts each. Two series receivers must simultaneously operate falsely to cause a trip and also one receiver in each parallel



BASEBAND ALLOCATIONS provide for extra channels. Only four of the ten alarm channels and 28 of the 40 relaying channels are in use at present

path simultaneously must fail to operate to prevent a desired trip. Additionally, either of the two trip paths may be tested without impairing normal operation of the other.

Positions of the guard contacts are monitored continuously, and any operation is recorded on an event recorder while setting off an "operation of relaying receivers" alarm. If a receiver alarm relay de-energizes, a microwave alarm is also initiated as "loss of relaying receivers."

Receiver relays are applied in circuits using six-contact, high-speed, auxiliary trip relays common on utility systems. They do not operate breaker trip coils. These relays can energize the tripping relay easily and can safely de-energize it if a protective circuit is used. An arc-suppression circuit is applied in parallel with the contacts.

Only one circuit is needed for each auxiliary trip relay, and it applies only on opening contact. The failure of any one of these suppression components cannot cause tripping, nor can it prevent it. The circuit eliminates arcing across the 0.004-in. contact clearance of the relay. Experience has been satisfactory except for harmonic interference, which is being corrected. Tripping time for the transfer trip function is at least 0.5 cycles less than the 6 specified for stability.

The remainder of the baseband up to 1.2 Mc is divided into 48 multiplex voice channels 16 kc apart. Seven are presently in use.

Multiplex equipment is also used as a channel for supervisory control equipment. The supervisory uses seven of the 19 frequency tones of the voice-frequency carrier band.

The 19 voice-frequency carrier channels may all be applied on each baseband multiplex channel. These are 150 cycles apart and range from 375 to 3,075 cycles. The system also combines supervisory and telemetering functions on one multiplex channel by using either channel 17 or 18 for telemetering and placing the supervisory on channels nearer the lower end of the voice frequency carrier spectrum. This telemetering is in addition to that performed as part of supervisory control and pertains to system net interchange and generation.

Each of the three repeater and two terminal stations uses the antenna-reflector type of installation with the antenna mounted within a few feet of the R. F. equipment and the reflector installed either atop a tower or on the generating plant stack. This permits a minimum of waveguide exposure.

Alarm No.	Code	Alarm Function			
		Dickerson Generating Station D	Quince Orchard Junction 118	Bells Mill Rd Sub 121	Burtonsville Sub 120
1	— ••••	R. F. Bay Switchover			
2	•— •••	Spare			
3	••— ••	Loss of Sta. Serv. on the Micropower			
4	•••— •	Loss of Relaying Receiver	Loss of Tower Obst. Lights	Loss of Relaying Receiver	
5	•••• —	Operation of Relaying Receiver	Loss of Tower Top Lights	Operation of Relaying Receiver	

ALARM DESIGNATIONS are quickly identified by operator from check list. The Master Alarm Detector is located at Takoma and monitors all other stations

The R. F. and multiplex equipments are installed either within the relay control houses or in outdoor metal cubicles located near the relay cubicles. The Quince Orchard and Bells Mill Road installations require special outdoor weatherproof cubicles.

The Quince Orchard repeater station has three cubicles—one each for the normal and hot standby R. F. equipment for two paths, and one for power supply controls, tower light controls and miscellaneous equipment. There are no relaying functions performed.

Cubicles Air Conditioned

The Bells Mill Road repeater station consists of four cubicles; the fourth contains multiplex equipment. Experience has shown that the cubicles must be air-conditioned and heated to prevent frequency drift, interference with R. F. sensing, or reduction of transistor life.

The reflector towers at Quince Orchard, Bells Mill Road and Takoma are respectively 275, 250 and 225-ft self-supported steel towers. They will withstand a wind velocity of 90 mph acting on 1.75 times the projected area of all members in one face. At maximum loading, the tower deflection is less than ± 0.5 deg in elevation and ± 1.0 deg in azimuth.

Towers are lighted and painted in accordance with FCC regulations. Lighting controls are installed either in the relay house or in the microwave cubicles.

Tower footings are the augered type composed of 30-in. dia columns with a 6-ft dia belled bottom and are 11 ft 6 in. deep. Footings are designed for a maximum uplift force and downward reaction of 156,000 lb with an allowable soil pressure of 4,000 psi and a safety factor of over two applied for the uplift. The use of augered footings saved about 30% compared with the usual formed pier, not only for the tower footing, but for the cubicle footing as well.

Each tower mounts two 8x12-ft aluminum reflectors, usually centered 5 ft below the tower top. However, one reflector was mounted at the 195-ft level of the 225-ft Takoma tower with special bracing. The 10x15-ft reflector at Dickerson Station is mounted 392.5 ft above the ground on the plant stack. To reduce corrosion by exhaust gases the reflector received a chemical treatment of irriditing and then three coats of chromate paint.

Determine Potential Transformer Accuracy

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Potential transformer performance is normally specified in terms of the ratio correction factor (RCF) and phase angle at given standard burdens which provide a common basis for designating accuracy. However, the actual burden which will be connected to the transformer secondary is seldom equal to the standard burden.

A straightforward determination of RCF and phase angle may be made at any secondary burden when test values at 0 volt-amp and any other burden are given. In addition, a complete graphical representation of the transformer capabilities, known as the "Farber Method," can show the performance at all desired burdens. By superimposing a standard accuracy parallelogram on this graph, all burdens at which the transformer will meet the standard accuracy class are immediately apparent.

Certified test programs of instrument transformer manufacturers provide performance data at 0 va and at least one other standard burden. With this data the performance at any other burden can be determined either graphically or analytically.

The graphical solution uses suitable scale factors for the RCF and phase angle axes of an accuracy class parallelogram. If scales are drawn such that a given distance represents 0.001 units on the RCF axis and 3.438 min on the phase angle axis, then the complete performance of the potential transformer can be graphically determined. The following information is required:

- A grid of phase angle in min vs. RCF with a scale factor ratio of 3,438 to 1 as shown in Fig 1.
- RCF and phase angle values at 0 va (NLR and NLθ) and at any other burden, VA_b (RCF_b and θ_b).

To determine the RCF and phase angle at all other burdens:

1. Plot the two sets of given performance data and draw a line connecting the two points. Points on this line represent performances at various burdens having the same power factor as VA_b.

2. Draw an arc with the center at the no-load point and passing through the performance point of VA_b. All points on this line represent performances at various burdens having the same volt-amp rating as VA_b.

3. After this reference angle and arc are established, complete the polar coordinate system of all desired burden power factors and volt-amp ratings. The volt-amp coordinates are arcs with the no-load point as a center and radii proportional to the radius of the reference arc. For example, if the reference burden is 200 va, then the 400-va arc will have a radius twice that of the 200-va arc.

4. The power factor coordinates are straight lines originating from

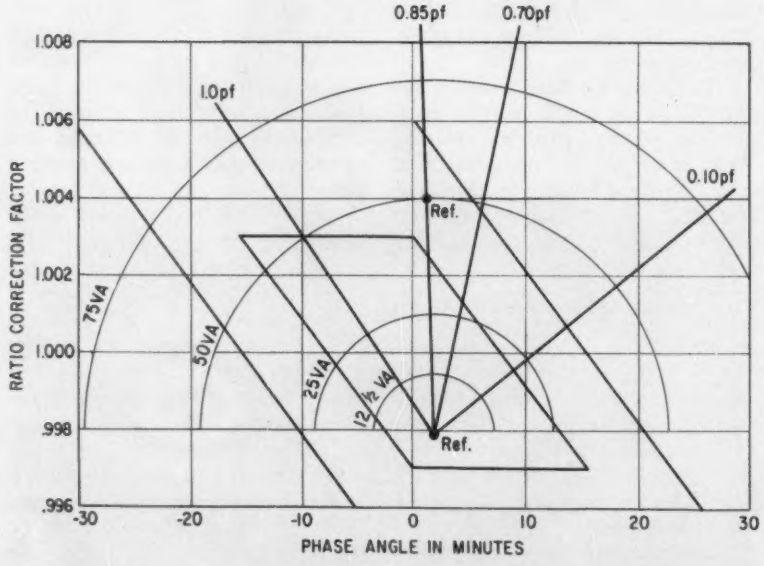


FIG 1—REFERENCE POINTS representing two sets of given performance data are plotted on grid. Points on the line connecting the two given burdens represent performances at various burdens with the same power factor as VA_b

Graphically

the no-load point. Angular positions of all other desired power factor coordinates can be measured from the line at the reference angle. The angle of rotation between two different power factor lines is equal to the difference in the power factor angles.

The power factor coordinates on the parallelograms are located more easily by using a protractor with divisions indicating cosines of angles, (power factors) instead of degrees. The protractor is placed on the graph with the no-load point at its center and the reference line aligned with its corresponding power factor division on the protractor. All other desired burden power factor coordinates are now located using the protractor as shown in Fig 2.

5. The ratio correction factor and phase angle for any unknown burden can be determined by locating the volt-amp rating and power factor on the polar coordinate system. The performance corresponding to this point is read directly from the RCF and phase angle axes.

Example.

Test results for a 2,400-120-v potential transformer are: burden, 0 va; RCF, 0.9979; phase angle +2.0 min; and burden, 50 va, 85% pf; RCF, 1.0040; phase angle, +1.0 min.

These two points are plotted in Fig 1. The length of the radius establishing the reference 50-va arc is 1 unit. Additional volt-amp coordinates for 75, 25, and 12½ va with radii of 1½, ½, and ¼ units, respectively, are shown. Power factor coordinates are added for 100%, 70%, and 10% burden power factors. Angular positions for these coordinates with respect

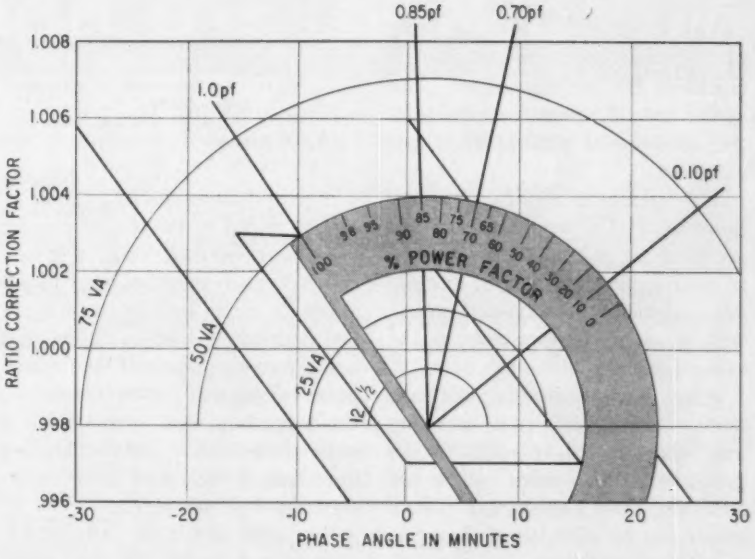


FIG 2—POWER FACTOR COORDINATES are located by using a protractor with divisions indicating power factors. Protractor is placed on graph with no-load point at center and reference line aligned with proper pf division

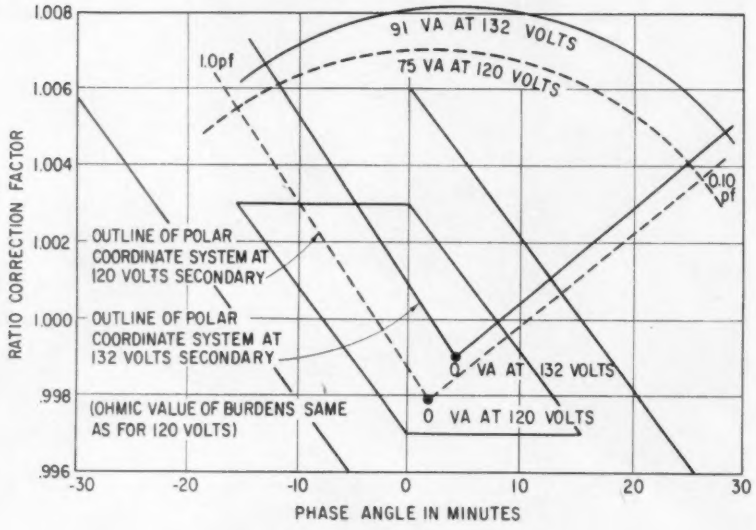


FIG 3—CHANGE IN VOLTAGE is accounted for by displacing parallelogram by the amount of change in no-load ratio correction factor (NLR) and phase angle (NLθ). Illustrated is the example voltage change from 120 v to 132 v

to the reference coordinate (85% power factor) are:

For 100% pf: B = arc cos 0.85 − arc cos 1.0 = 31.8 deg
For 70% pf: B = arc cos 0.85 − arc cos 0.7 = −13.8 deg
For 10% pf: B = arc cos 0.85 − arc cos 0.1 = −52.5 deg

The direction of rotation from the reference coordinate is counterclockwise for positive angles. Use of the special protractor eliminates the necessity of making these calculations.

This system is applicable to any frequency. The two reference test points must, of course, be obtained at the specific frequency of interest. All graphically determined points will represent performance at the same frequency as the test points.

If the leads connecting the burden to the transformer are very long, they may have sufficient impedance to introduce additional RCF and phase angle errors. These errors can be included in the polar coordinate system so that their effect at any burden is readily apparent. This is done by correcting the reference test point at burden VA_b to include RCF and phase angle due to secondary leads. These changes can be calculated from the following equations:

$$\text{Change in } RCF_b = \frac{VA_b\,(R_L \cos\theta_b + X_L \sin\theta_b)}{E_s^2}$$

$$\text{Change in } \theta_b = \frac{VA_b\,(R_L \sin\theta_b - X_L \cos\theta_b)}{E_s^2} \times 3{,}438$$

where R_L = total resistance of secondary leads, ohms
X_L = total reactance of secondary leads, ohms
E_s = secondary voltage, volts
3,438 = number of minutes in one radian

These changes in RCF_b and θ_b can be added to the test results for the known burden, VA_b, to give a new reference point which will account for errors both in transformer and secondary leads. Using this new reference point and the no-load point (which will not be affected by the secondary lead impedance), a polar coordinate system including the effect of secondary lead impedance can be constructed.

The tests shown on certified test reports are made at the rated terminal voltage of the potential transformer, usually 120 v, and, therefore, all points graphically determined from these test results apply only at rated terminal voltage. The only additional information required to determine performance at another voltage is the measured no-load ratio correction factor (NLR) and phase angle (NLθ) at the new voltage.

The location of the polar coordinate system on the RCF and phase angle axes will be shifted by the amount of change in NLR and NLθ. Fig 3 illustrates this effect for the transformer in the example problem of Fig 1 if the terminal voltage is changed to 132 v. The polar coordinate system for rated terminal voltage is reproduced exactly, except that the no-load point and the known burden point (as well as all points in the polar coordinate system) are displaced by the amount of change in the no-load ratio and phase angle points.

The volt-amp coordinates on the original graph are based on rated terminal voltage. The ohmic values of the burdens in the 132-v system are the same as those for corresponding points in the 120-v system, and therefore the volt-amp coordinates for the new polar coordinate system must be marked to correspond with the actual burden volt-amp at the operating voltage, as follows:

$$\text{VA at operating voltage} = \left[\frac{\text{operating voltage}}{\text{rated voltage}}\right]^2 [\text{VA at rated voltage}]$$

In the example shown in Fig 3, the coordinate marked 75 va at 120 v in Fig 1 is marked as $\left[\frac{132}{120}\right]^2 \times 75$ or 91 va on the 132-v diagram.

Since this method is theoretically accurate[1], all graphically determined results will have the same degree of accuracy as the given test data.

It should be re-emphasized that in order to use this method it is essential that the proper scale relationship be maintained for the RCF and phase angle axes.

[1]The Analytical and Graphical Determination of Complete Potential Transformer Characteristics, by Settles, Farber and Conner, AIEE Transaction Paper No. 60-1246, October, 1960.

A Special Report

Aerial and spacer cable promise attractive pole plant, capable of reliable service despite storm-felled trees . . .

Courtesy Line Material Industries

. . . While buried cable from artistically styled transformers serves new home developments in

Distribution for the Future

LEONARD M. OLMSTED, Senior Editor

Methods devised by utility engineers in recent years to solve their most pressing distribution problems reveal the pattern of distribution for the future. The key to this pattern is cable.

Cable has been applied in many ways since Edison used it for historic Pearl Street. But increasingly frequent installations to clear congested areas, to get circuits on routes where clearances are inadequate for open wires, or to guard against tree interference have spurred a drive to overcome its cost differentials.

An early move was to aerial installations to avoid the cost of underground conduit. Help has come, too, from new insulating materials developed by the chemical industry which can be extruded onto wire to make cable durable enough for use through trees and for direct burial in the ground.

Costly methods of putting transformers and related equipment underground have also come under attack. Pioneering development of the partially buried kiosk led the breakthrough. Today most manufacturers offer relatively stream-lined transformers or enclosures for pad mounting.

Thus utilities today are in a position to offer underground distribution at less than the traditional increment over overhead system costs. They can also provide clean, aerial-cable distribution in many areas at a cost approaching parity with open-wire plant. And their customers have demonstrated a growing insistence upon quality service and some inclination to contribute to the cost of getting it.

Distribution for the future is in its infancy today. But its trends are revealed by information from nearly 100 utilities across the US and Canada. An analysis of this information and articles about two recent installations are assembled in this Special Report under these headings:

Distribution Design Swings to Cable.....p 50
Transformers Need Re-evaluation.....p 54
Aerial Cable Key to Storm Proofing.....p 57
Suburb Puts Distribution Underground....p 62

Distribution Design Swings to Cable

Underground spreads in residential developments, largely with buried cable and pad-mount transformers; overhead systems turn to aerial cable for primaries and secondaries

Changes in distribution design in the US and Canada today promise sudden and premature obsolescence in practices which have enabled electric utilities to stay ahead in per-capita consumption.

• Residential underground distribution has won a place in the programs of 78% of major utilities in the US and 73% in Canada. And today it serves—or has been proposed to serve—nearly 44,000 homes. This progress has come from vigorous promotion of buried cable systems by the few utilities revealed to be pioneers in this field by Electrical World's 1957 survey (Aug. 12) and its adoption by many utilities more or less opposed to it at that time.

• Aerial cable, Electrical World's 1954 survey (May 17) reported, was used by 60% of reporting US utilities to circumvent tree trouble and to improve plant appearance or facilitate a second primary circuit on a pole line. It has now gained acceptance by 70% of US and 55% of Canadian utilities. Several large-scale installations have grown from adoption of aerial or spacer-type cable in expansion and rebuilding programs.

• Aerial cable has gained acceptance by 36% of US and 27% of Canadian utilities for secondary construction. Over a third of these look forward to extensive installations because of its use in their expansion programs.

• Grounding practices are beginning to reflect the growing use of non-metallic pipe in water systems.

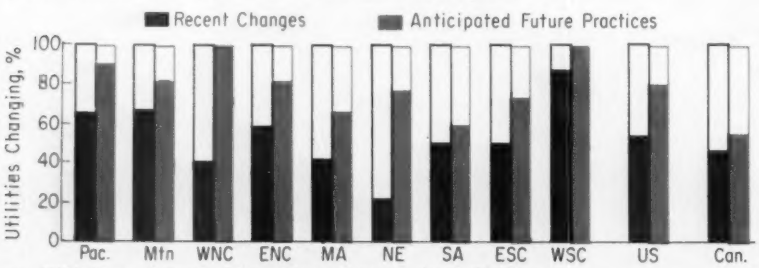
These conclusions are indicated by Electrical World's newest survey which has assembled data from 78 utilities in 42 states serving over 60% of US meters and 11 utilities in five provinces serving about 40% of Canada's meters.

The rapidity of these changes is charted below for residential underground, new methods of installing transformers, and adoption of aerial cable. Black columns indicate the number of utilities in each area which have adopted new practices during the past five years. Blue columns show how many expect to be using new practices within five years. Unless system growth encounters an unforeseen setback, these new practices still considered experimental by most utilities, seem destined to play a major role in future distribution.

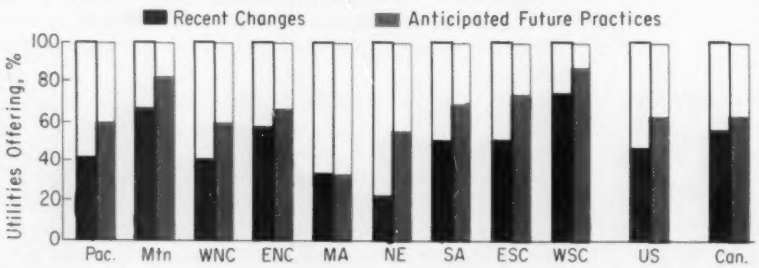
Underground residential service is offered today by 70% or more of reporting utilities in every geographic region except New England where only 45% have provision for it. The total is 78% of US and 73% of Canadian utilities. In practically every case the underground service is offered on the basis that the customer or his builder contribute in work or money the increment over open-wire distribution costs, although a growing number of utilities offer refunds as an inducement for installations of high-use appliances and heating. Electric rates, except for two utilities in 69, are the same as for conventional service. And 93% of these utilities maintain the underground facilities free of charge, although 15% decline to dig up service cable on customers' properties.

An important step in cutting underground distribution costs has been direct burial of the cable. This practice for primaries ranges between a low of 25% of participat-

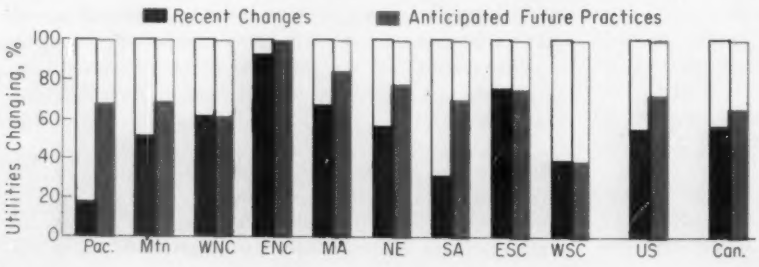
More Residential Distribution Goes Underground .....

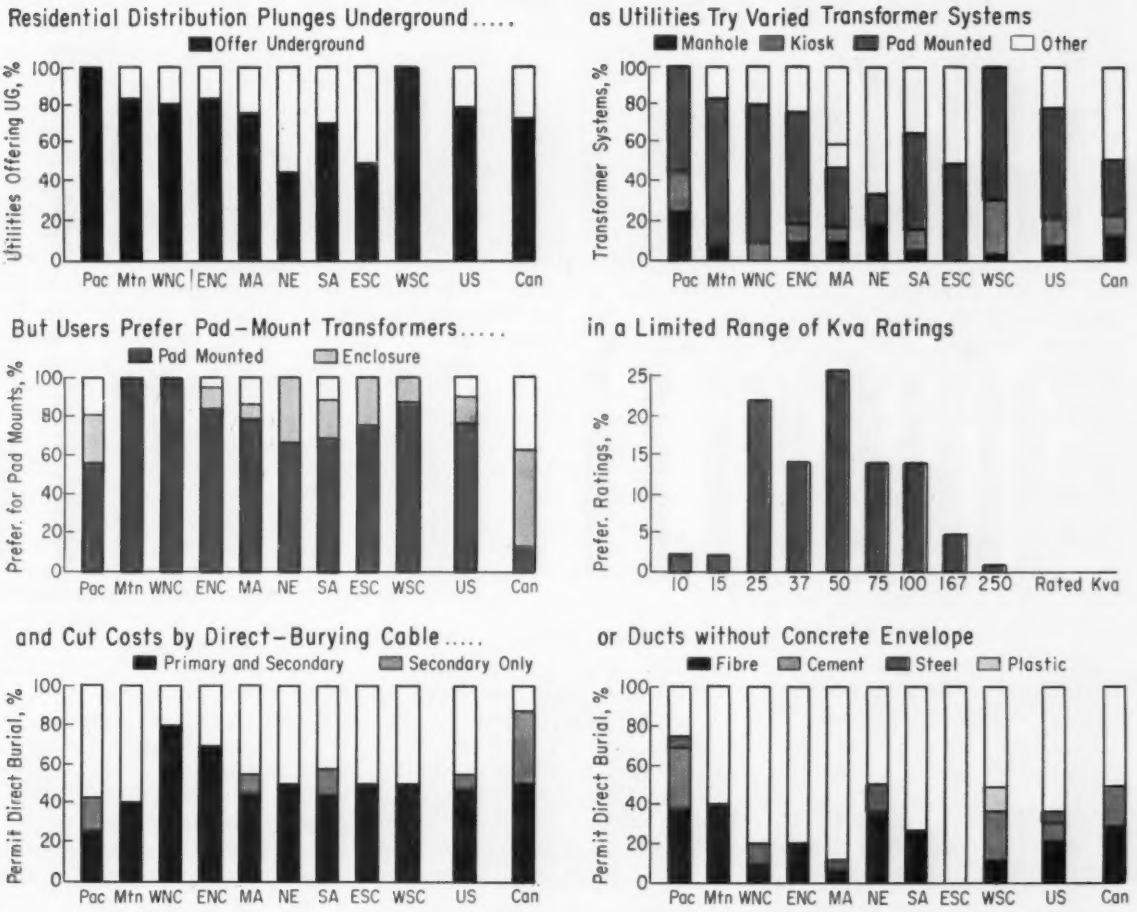


as Utilities Adopt New Transformer Installations .....



and Aerial or Spacer Cable Wins Acceptance on Many Systems




Residential Distribution Plunges Underground.....
Offer Underground
Utilities Offering UG, %
Pac Mtn WNC ENC MA NE SA ESC WSC US Can
as Utilities Try Varied Transformer Systems
Manhole Kiosk Pad Mounted Other
Transformer Systems, %
But Users Prefer Pad-Mount Transformers.....
Pad Mounted Enclosure
Prefer. for Pad Mounts, %
in a Limited Range of Kva Ratings
Prefer. Ratings, %
10 15 25 37 50 75 100 167 250 Rated Kva
and Cut Costs by Direct-Burying Cable.....
Primary and Secondary Secondary Only
Permit Direct Burial, %
or Ducts without Concrete Envelope
Fibre Cement Steel Plastic

ing utilities in Pacific States and a high of 80% in West North Central, averaging 48% for US utilities and 50% for Canadian. For secondaries, the range is from 40% in Mountain States to 80% in West North Central for a US average of 55%; Canadian utilities go 88% for direct-buried secondaries. The majority of these utilities specify sand or screened-earth backfill and some, concrete slabs or creosoted planks for additional protection. Other utilities, while requiring ducts, permit direct burial of fiber, soapstone, asbestos cement, or plastic ducts without the customary concrete envelope. And many look to

Underground Conductor Preference Needs Clarification...

	Primaries		Secondaries	
	US	Canada	US	Canada
Copper	22%	25%	17%	25%
Aluminum	2%	–	3%	12%
Not specified	76%	75%	80%	63%

Insulating Materials Show Wide Range...

	Primaries		Secondaries	
	US	Canada	US	Canada
Polyethylene	14%	19%	7%	25%
Neoprene on rubber or butyl	8%	25%	30%	25%
Rubber or butyl	22%	19%	33%	25%
Polyvinyl chloride	2%	–	5%	25%
Lead on rubber	9%	–	–	–
Lead on paper	14%	25%	2%	–
Not specified	31%	12%	23%	–

Lightning Protection Specified for Pad Mount Units...

	US	Canada
In units or enclosures	48%	50%
On cable terminal poles	45%	38%
None or not specified	8%	12%

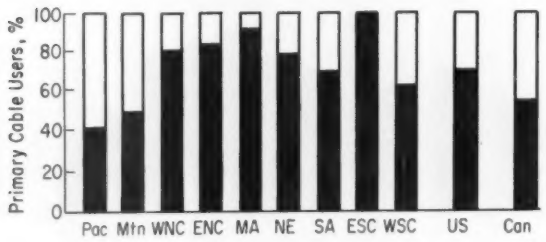
Short-circuit Protection for Pad Mount Units...

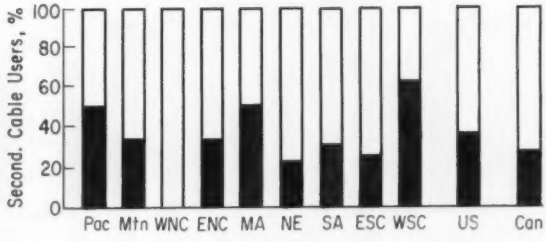
	US	Canada
Fused cutouts on units	76%	75%
Secondary breakers on units	11%	12%
Fused cutouts on terminal poles	12%	13%
None or not specified	5%	–

Pad Mounts for Three-Phase Service...

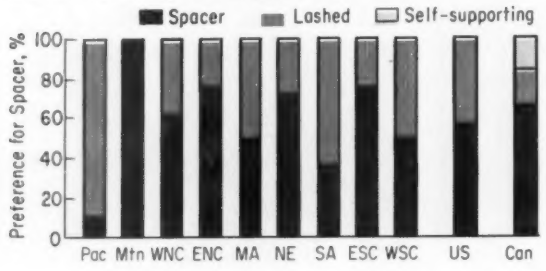
	US	Canada
Three-phase units	22%	25%
Two or three single-phase units	21%	38%
None or not supplied	57%	37%

Many Utilities Try Aerial-Cable or Spacer Primaries..... and Some Turn to Cable for Secondaries

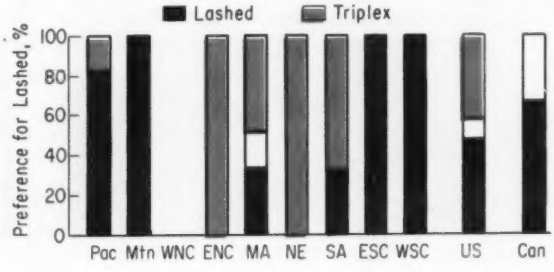




Users Prefer Spacer-Type Primaries.....



and Lashed or Triplex Secondaries



sharing the trench with telephone cable for additional economies.

Choice of cable for these underground systems shows a wide range —from polyethylene over aluminum to paper-lead over copper. But the preference is for rubber or butyl, with or without Neoprene jackets.

Probably of equal importance in this swing to underground distributions has been the development of pad-mounted transformers and enclosures. These have already gained 71% acceptance by US utilities offering residential underground and 31% in Canada. Preference for future use boosts the pad mount to 77% for US utilities, complemented by 13% for pre-fabricated enclosures. But in Canada the preference is 50% for enclosures and 13% for pad-mounted transformers.

Specifications for pad-mounted transformers reveal a growing com-

Aerial-Cable Conductor Preference Aluminum...

	Primaries		Secondaries	
	US	Canada	US	Canada
Aluminum	55%	–	72%	67%
Aluminum alloy	–	–	5%	–
ACSR	–	–	2%	–
Copper	32%	67%	18%	33%
Not specified	13%	33%	3%	–

Insulating Materials Varied...

	Primaries		Secondaries	
	US	Canada	US	Canada
Polyethylene	41%	–	31%	67%
Neoprene	–	–	24%	–
Neoprene on rubber	13%	33%	7%	–
Rubber	25%	17%	16%	33%
Lead on paper	3%	33%	–	–
Not specified	18%	17%	22%	–

Cable Terminations...

	Primaries		Secondaries	
	US	Canada	US	Canada
Tape (incl. cones)	64%	50%	75%	100%
Potheads	14%	25%	–	–
Other devices	13%	25%	–	–
Not specified	9%	–	25%	–

Lashing Wire or Tape for Lashed...

	Primaries		Secondaries	
	US	Canada	US	Canada
Copper	50%	–	11%	33%
Copperweld	27%	50%	4%	–
Aluminum	–	–	14%	–
Stainless steel	6%	–	14%	–
Steel	4%	50%	4%	33%
None (Triplex)	–	–	42%	–
Not specified	13%	–	11%	33%

Messenger Material Varied...

	Primaries		Secondaries	
	US	Canada	US	Canada
Copperweld	80%	66%	14%	33%
Copper	–	–	2%	–
ACSR	1%	–	50%	33%
Galvanized steel	8%	17%	16%	33%
Aluminum	–	–	5%	–
Aluminum alloy	–	–	5%	–
Self-supporting	–	17%	–	–
Not specified	11%	–	7%	–

plexity of requirements. Not only are they sought in a variety of sizes and voltage ratings, but also with varying demands for lightning arresters, circuit switching, and overcurrent protection. Scattered utilities seek designs for higher supply voltage than 13 kv; others want special switching for looped primaries, with a visible break to satisfy safety practices. This complexity adds to the cost, yet the manufacturers are reluctant to ask for standardization lest too early freezing impede experimentation which could lead to more desirable designs. In this respect, utilities can help both manufacturers and themselves by carefully evaluating new schemes before specifying design changes and by working toward standardization as early as possible.

Suggestions for future underground use included one for secondaries and service at 480 v and several for direct-buried encapsulated transformers. In this, the survey shows the stage set for trial use of the encapsulated units announced last week (p 66).

Aerial Cable Ready

Aerial cable seems about ready for utility expansion programs, after years of use only to solve specific needs. Much of the credit for this progress must be given to the spacer type which gives the desired accessibility for hot-line work and, because its covering carries a lower insulation rating than is required for lashed cable, permits line costs to be held at levels more comparable with those of open-wire.

Spacer cable has until recently been considered questionable for circuits operating at more than 5 kv. But the 55% overall preference reported for the spacer type, even among utilities operating at 12 to 13 kv, implies confidence that difficulties encountered in early installations at this voltage level have been overcome. One utility is seeking to extend spacer construction to 34.5 kv. But a few are proceeding cautiously until they have a chance to observe the spacer system's ability to withstand sleet.

Terminations for the spacer cable were usually reported as "taped" or "on deadends" or "taken into cutouts," much like the open wire it replaces. This relative simplicity, even though stress cones and more care may be required for higher voltage installations, certainly has a bearing on the high preference reported for spacer.

For secondary service, aerial cable has fewer users (only 36% of US and 27% of Canadian utilities), but among these it is more frequently applied in expansion programs. Explanation of this seeming contradiction may be found in the claim of several advocates that aerial-cable secondaries with span-supported triplex services cost no more and look much better than conventional open wire. One of the Canadian utilities reports that this construction will permit spans up to 250 ft in lieu of the present 135 ft. It seems logical to conclude that a marked swing to aerial-cable secondaries will be one of the early changes in distribution for the future.

Grounding Practices Modified

Finally, the survey inquired into grounding practices for pad-mounted transformers and service connections. And it found grounding for the pad mounts frequently by combinations of several methods. Of the US utilities using, or planning to use, pad-mounted units, 77% drive rods or bury grids, 8% connect to water piping, and 55% tie in the multigrounded system neutral. In Canada, 62% drive rods, 12% connect to water piping, and 75% tie in the neutral. The extent by which these percentages exceed 100 gives a measure of the use of two methods. In addition, many of the utilities depending on driven grounds specify two or more while others specify resistance under 25 ohms.

The picture of customer service grounding is clouded by the fact that prime responsibility for it rests with the wiring contractor and the agency which inspects his work. Some respondents indicated accordingly and declined to answer. But among utilities which did report, there is evidence of a growing concern about the effect of non-metallic water piping reportedly in use in about half the survey area in both the US and Canada. About one utility in every four or five affected by such piping has already specified tests to prove low resistance, adopted ties to the multi-grounded system neutral, or recommended driven rods to assure customer safety. As many more plan such steps in the near future. Last but not least, several electric utilities propose cooperative action with other utilities, including water, and the code agencies to establish affective uniform grounding practices in their service areas.

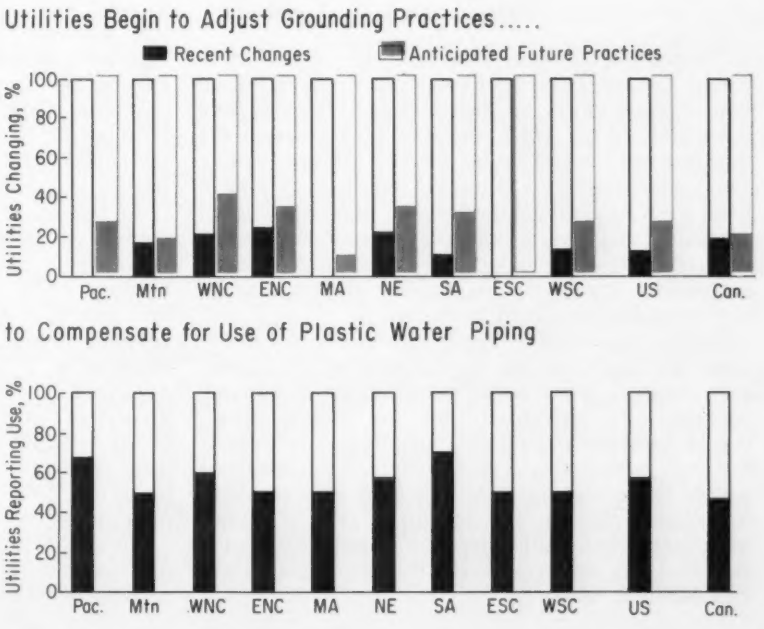
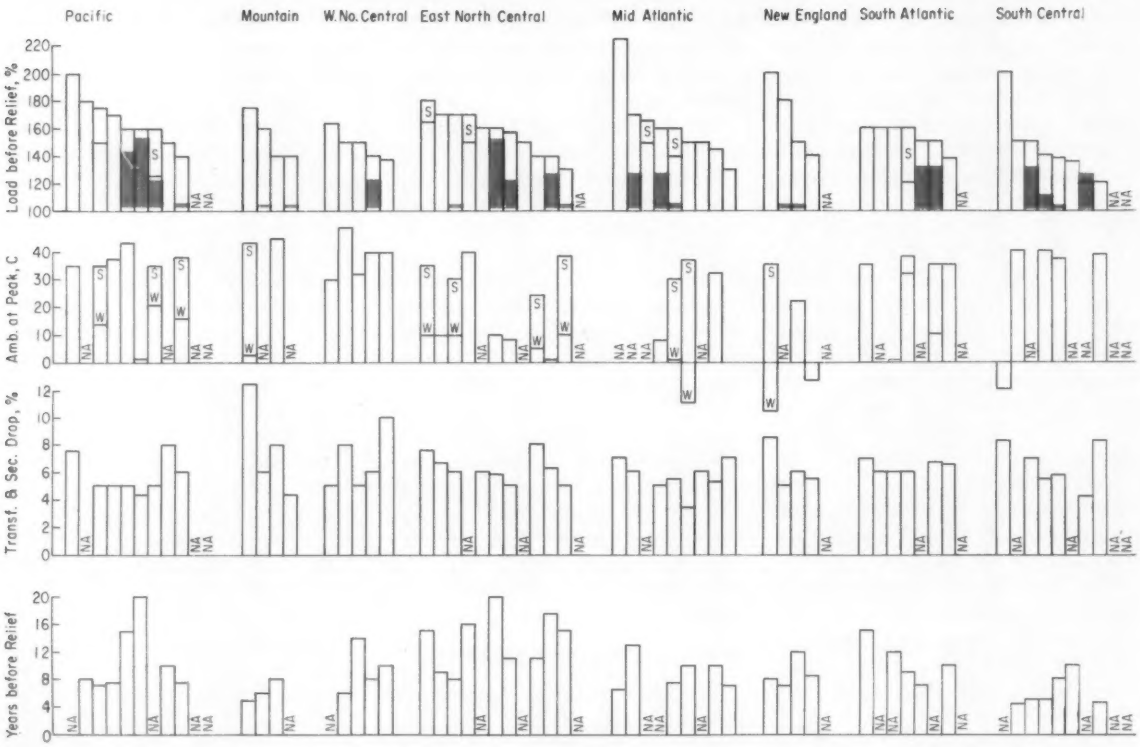


Chart 1—Loading Reflects Ambient, Regulation, Changeouts



COLORED AREAS, where shown, indicate loading assumed by utility in evaluating copper loss of transformers

Distribution for the Future

Transformers Need Re-evaluation

Loss ratio, total losses, and voltage regulation must be analyzed for today's core steel and insulation to pick best values

Distribution engineers today have an opportunity to choose the loss ratio, total losses, and voltage regulation of transformers for their systems. These choices have been added within the last three years to the time-honored ones of rating, loading practice, voltage class, and protection. Thus the transformer, long a focal point in distribution planning, must be assigned additional variables in tomorrow's economic evaluations. And these evaluations must be adapted promptly to industry standards lest decades of conscientious standardization vanish in confusion.

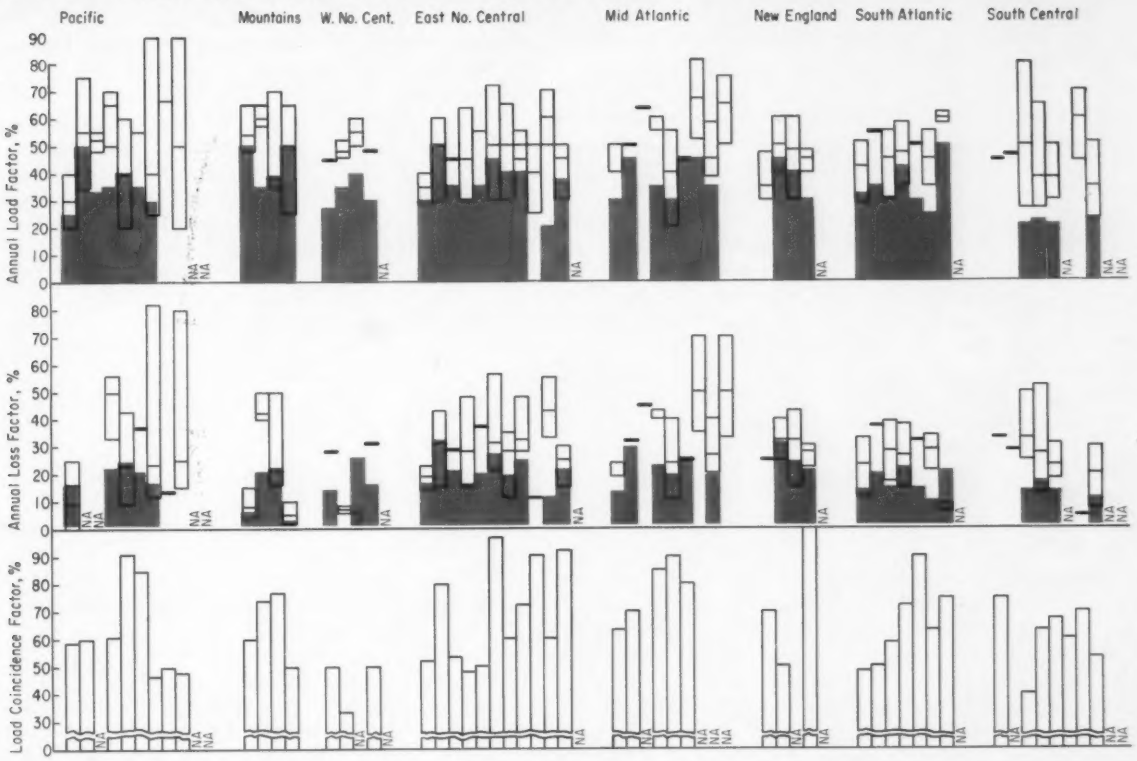
These new variables do not violate existing standards. Rather, they are an opportunity to change values evolved by competing manufacturers in applying improved core steels, insulations, and internal protection to transformers for utility use. Transformers over the years have shown a gradual decline in losses and voltage drop. But the ratio of copper to core losses held close to the 3:1 ratio adopted in 1932 or earlier, when intentional overloading was discouraged by the manufacturers and copper losses probably averaged less than full-load values.

Ensuing years have brought considerable overloading, spurred by the ASA loading guide and by CSP manufacturers. The latter claimed first that breaker tripping would protect the transformer against overload damage, later promoted loading until the light signaled a changeout for economical operation. Thus loading has been boosted to 150% or more before changeout, and average loading during service life must be about 125%. Copper losses for such loading would run at least 50% above values published for nameplate loading and should be evaluated accordingly.

At this point, it seems appropriate to consider the impact of a movement initiated last April to boost the allowable average temperature rise of a transformer winding to 65C. This does violate the long-established limit of 55C in ASA standards. Several manufacturers, adopting new insulation structures, announced rating increases of 12%. Others applied margin in existing designs to sanction 12 to 20% over nameplate loading. Thus most distribution transformers gained new ratings of 112 to 120% nameplate. But with coils unchanged, their regulation increased proportionally and copper losses rose 26 to 45%. And thus a design for 3:1 loss ratio at 55C became about 4:1 at 65C.

Up to this point, it has been assumed that all distribution transformers are loaded as are those serving residential customers. This, obviously, is an over-

Chart 2—Load Factor Is Element of Loss Evaluation



BLACK OUTLINE shows range of load factor and loss factor reported; intermediate or isolated bar marks "typical" value

simplification because some, particularly the larger sizes, serve commercial or light industrial customers. The common practice of restricting overloads on commercial and industrial installations to compensate for the longer cyclic load period tends to make high rated copper losses less uneconomic. But it would seem prudent to design the larger transformers—say 50 kva and larger—with loss ratios selected for economical use on commercial and industrial load cycles.

Utility engineers have long questioned whether they are getting the optimum characteristics in distribution transformers. Today they have a unique opportunity to tell the manufacturers what they want. But before they do it, they must answer these two questions:

1. Would a reduction in copper loss, offset by sufficient boost in core loss to maintain the product (some manufacturers say "sum") of losses and hold the cost constant, give overall economy?

2. Would a reduction in copper loss without a boost in core loss, making for a reduced product (or sum) of losses and higher manufacturing cost, give over-all economy?

To answer these questions, they need certain analytical data about loading practices and energy costs. And, if their findings are to bring savings through development of more suitable transformers, their analyses must lead to industry specifications. They must define a single line of transformers which will be best for all major users, despite wide variations in load characteristics and ambient temperatures.

What data do they have? Electrical World has assembled in three charts information from 64 US utilities serving about 52% of the nation's meters.

Transformer management (Chart 1) is measured in part by the maximum loading permitted before change-out or relief. This loading may be limited by hot-spot temperature, in which case a lower value would be expected in South Atlantic and South Central states where peak loads occur in summer. Or it may be limited by voltage drop.

Favorable utilization voltage, according to EEI-NEMA Preferred Voltage Ratings, is 110 to 125 for a 120-v system. Allowing 3-v drop in services and building wiring, and 1 v in a lightly loaded transformer, the spread available for the distribution regulator, primary circuit, transformers, and secondaries is 113 to 126 v, or 10.4% on 120-v base. At least 5.4% spread (probably 6% for a 12-kv system) should remain for transformer and secondary drops. Such a spread would permit 150% load on modern transformers and leave 2.5% for secondary drop to the last service pole.

Under such circumstances the most logical method for relieving an overloaded transformer would be by adding a second transformer to share the load. And 44% of the replies indicated a preference for this method, compared with 6% who prefer to replace in place. But replacing in place is often practicable as the second round after splitting the bank gives voltage relief, so it is not surprising that 39% use both.

Transformers with reduced copper losses have been offered by several manufacturers. Their primary objective is, of course, to gain economy by holding down energy losses at high loading. But an added advantage is a reduction in voltage regulation which can boost

revenue by holding customer voltage nearly a volt higher with low-ratio transformers overloaded to the same percentage as normal-ratio transformers. Alternately, the low-ratio transformers can be overloaded more severely to deliver the same voltage as normal-ratio transformers. But only 25% of the survey replies reported evaluations of voltage regulation.

Years in location before relief is another element of transformer management. It is controlled by the capacity allowed for growth when a transformer is installed and by the load growth actually experienced. Periods reported ranged from 5 to 20 years, the shorter one probably reflecting uneconomical expenditures for changeouts while the longer time may indicate excessive carrying charges for capacity to serve future load.

Transformer loading (Chart 2) should reflect climatic conditions. Thus the South Atlantic and South Central utilities' pronounced air-conditioning loads, and the Mountain and Pacific utilities' house-heating loads, might be expected to cause low annual load factors. Actually, however, their data show more variation between utilities of each geographic group than between groups. Although some scale down high load factors in evaluating losses, as shown by color in Chart 2, their assumptions come no closer to a norm than do the original load factors.

Loss factors are customarily computed empirically from load factors. Thus they show the same extreme variations and offer the same difficulty in selecting a value for standardizing transformer designs.

Coincidence factor has an important bearing on the evaluation of copper losses in determining their demand at system peak. Reported values—from 33 to 100%—offer little hope for industry agreement.

The ultimate objective in such analyses must be appropriate penalties for core losses and copper losses. These are determined by at least three methods:

1. Losses should be considered as part of the load and should be charged for demand and energy at the same average costs as are used to establish service rates.

2. Losses should be considered as increments to the load and should be charged for demand and energy at the same incremental costs as would be used for a corresponding increase in system load.

3. Losses should be charged on a kwhr basis comparable to the purchase or sale of power.

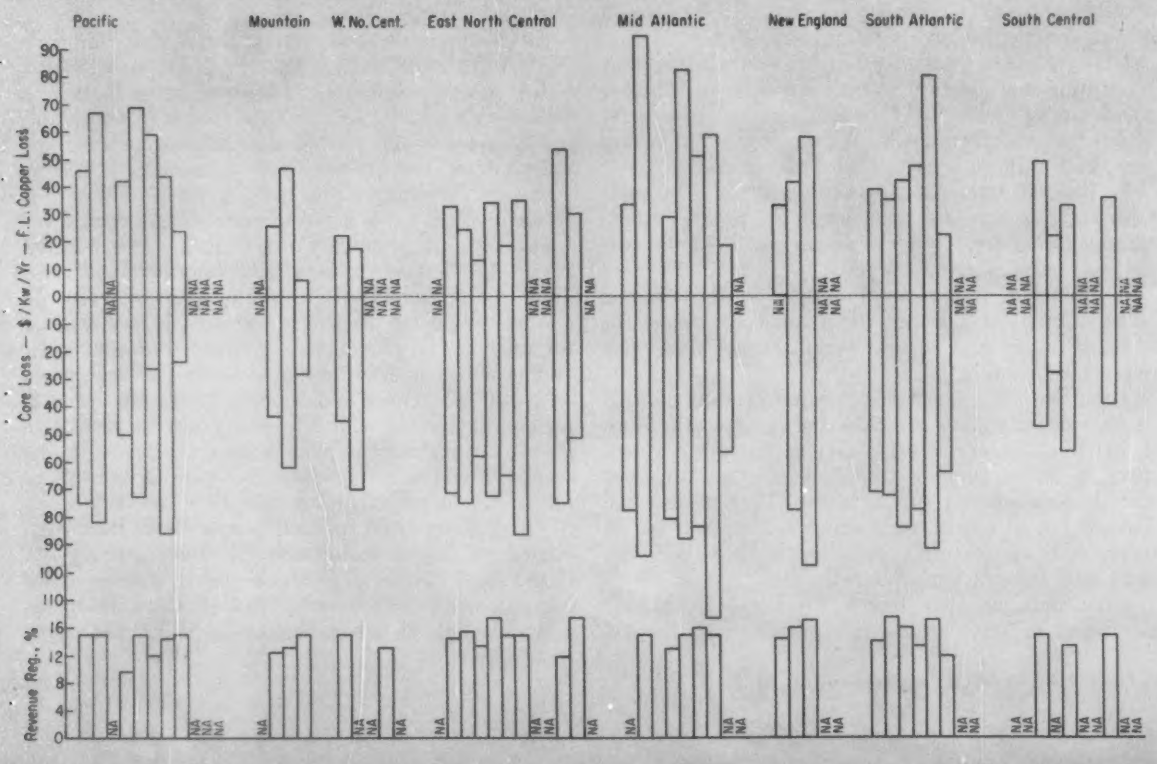
The first two would probably give different values but should retain somewhat similar ratios between charges for core and for copper losses. But the third method penalizes core loss by failing to credit it for 100% LF, and favors copper loss by failing to penalize it for low LF.

Core loss has no diversity and requires more than one kw of generating capacity and 8,760 kwhr of fuel for every kw of loss; this could total from $50 to $100 per year, depending upon the type of generating plant and its annual revenue requirements. Copper loss usually has diversity, however, and requires less than one kw of generating capacity per peak kw; it also consumes less fuel, so its evaluation should be lower.

Most replies showed annual demand and energy charges per kw, presumably at nameplate losses. The others were converted to this basis, using reported evaluation loadings and/or annual revenue requirement. Resulting values for full-load copper and core losses are shown in Chart 3.

Certainly there is reason for wide variations. But industry specifications for transformers will be difficult until individual utilities come closer to agreement on the values which control decisions.

Chart 3—Value Set on Losses Shows Wide Variation



Still working after Donna's blast . . .

Aerial Cable Is Key to Storm-Proofing

G. A. EWALD, Distribution Plant Engineer-Overhead, Public Service Electric & Gas Co, Newark, N. J.

Determination to build into overhead distribution the reliability to ride through hurricanes and severe winter storms has prompted Public Service Electric & Gas Co to adopt extensive innovations in design and construction practices. Most striking of these is the wholesale use of lashed and spacer-type cable for 4-kv and secondary spans. Abandonment of open wire on crossarms, elimination of series street lighting on distribution poles, and adoption of an insulated, high-strength primary plant have combined to achieve the desired gain in service reliability.

The new practices grew out of the week-long struggle by Public Service crews, augmented by task forces from other utilities, to restore the system after the paralyzing snow storm of March 1958. Critical examination of storm procedures and plant construction practices, spurred by that storm, sought means to restore service in the minimum possible time. It was soon recognized that substantial improvement in restoration time would require a material reduction in plant damage. Accordingly design changes were proposed to make new construction as completely storm-resistant as practicable.

This work, tested by several square miles of trial installations and cost studies, culminated in May 1959 in the adoption of new standards for transmission and distribution construction and reinforcements. Existing plant is being converted to the new standards wherever necessary to achieve desired results. Starting at locations where storm damage has been severe, the modification program will extend in time to all vulnerable sections.

Hurricane Donna last September gave the new distribution a severe test. This storm, its severity proved by US Weather Bureau records and the trail of destruction it blasted along the eastern seaboard, interrupted service to 230,000 Public Service customers for periods up to two days. But there was a striking lack of trouble in areas where distribution had been built or re-built to the new standards.

The 10% of the utility's pole-line miles of distribution that had been converted came through this ordeal

LASHED-CABLE PRIMARIES, multiple street lighting cut hazard of trees to open wire in suburban Maplewood

Distribution for the Future

with only 30.7 cases of primary damage per 1,000 miles. This trouble rate was only 18% of the 170.7-cases-per-1000-miles rate experienced on the rest of the system which was still of conventional open-wire construction. The comparison is more impressive than the figures indicate because the new standard construction was in heavily-treed areas which are historically most vulnerable to storm damage. In many locations, the aerial cable remained in service despite extreme mechanical loads imposed by falling limbs and trees which would have demolished open-wire distribution.

Added Strength Was Basic Need

Basic objective in the new design is a major increase in pole-plant strength. Distribution spans in urban and suburban areas are limited to 175 ft. Poles are set with particular care, using cribbing, keys, and extra depth settings where normal guying cannot be installed to hold conductor loading. Storm guying and details resemble subtransmission practice.

Polyphase primaries are fully-insulated factory-lashed aerial cable at substation outlets, in congested locations, along residential rear-property lines, and where tree conditions create excessive hazard. Spacer cable is specified for most other locations. Conductor sizes are standardized as No. 2/0 and 397.5-MCM all-aluminum or equivalent copper, except at a few locations where 600-MCM, lashed, all-aluminum cable is required for capacity. All aerial cable has a messenger of sufficient conductivity to serve as a common neutral.

Insulation Butyl, Neoprene Jacket

Insulation of the lashed cable is 155 mils of butyl rubber on No. 2/0 and 170 mils on larger sizes; jackets are 65 mils of neoprene. The spacer conductors have 78 to 109 mils of butyl and 45 to 65 mils of neoprene jacket.

Single-phase primaries are high-strength tree wire with minimum breaking strength of 4,000 lb, supported on pole-pin brackets. No 1/0 AAAC, covered with 78 mils of butyl and 45 mils of neoprene, has been used but other conductors are under consideration. A second phase conductor of similar material is installed when required on a hook bracket mounted below the pole-pin bracket.

If a secondary is present, it is put in cable and the cable messenger is the common neutral. If secondary is not present, the neutral is of the same conductor material as the phase wire but without insulation. In this case, it is installed in secondary space on the poles

SPACER-CABLE PRIMARIES, lashed-cable secondaries, and cluster-mounted transformers clear exposure at school site

HIGH-STRENGTH TREE WIRE on pole-mounted insulators replaces two open wires of 4 kv in trees at corner

where it serves as the common neutral conductor.

If a third phase becomes necessary, a third similar conductor is run in and all three conductors are grouped with a messenger in spacer construction.

Street Lights Converted to Multiple

All new street lights, except those on poles carrying no other services, together with lights replaced in modernization programs, are connected in multiple with photo-cell control from the secondaries. Thus series street-lighting wires are eliminated and line crossarms become unnecessary. Public Service now operates 80,000 multiple street lights, approximately 43% of the company's total.

Distribution transformers are mounted directly on the poles, except some 3-phase units designed for hanger mounting only which are installed on 4-ft crossarms. Completely-self-protected transformers, both single-phase and polyphase, are connected to the primary cable with insulated disconnects. Cutouts and lightning arresters for conventional transformers are mounted on the tanks or on suitable brackets. All transformer tanks are grounded to the common neutral wherever there is no open-wire construction.

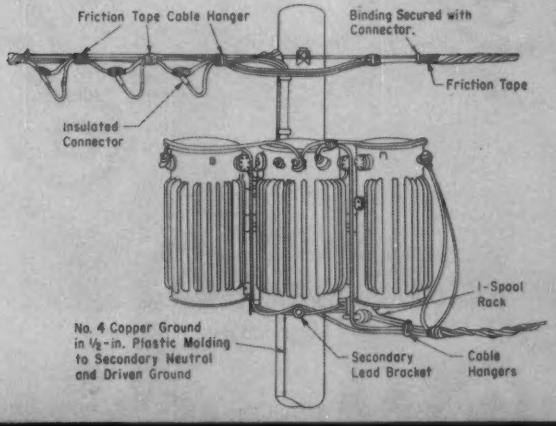
Secondary mains are fully-insulated, reverse-lay, factory-lashed aerial cable supported by a messenger. Three-wire and four-wire cables are used as required, and standard conductors are No. 2/0 and 397.5-MCM all-aluminum or the equivalent sizes in copper, with rubber insulation and neoprene sheath.

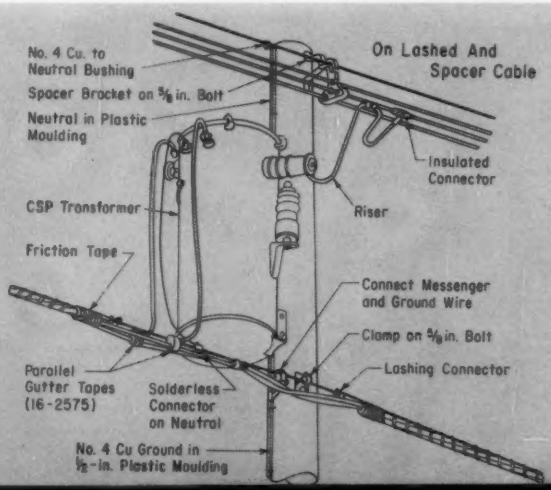
Service drops are also cable, supported by attachment to the secondary messenger and by two attachments to the customer's building unless a single-eye bolt can be run through a structural member. Minimum neutral size for 3-wire and 4-wire service drops is No. 4 aluminum alloy or its equivalent in strength. Phase conductors are No. 4 to No. 2/0 aluminum, secondary cable being used where larger conductors are required.

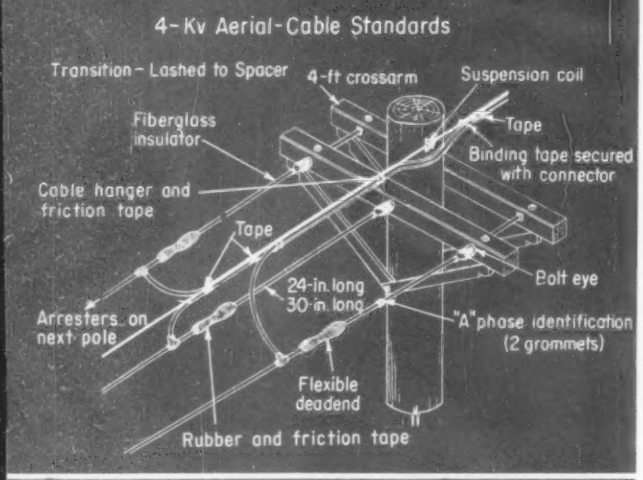
Existing Plant Rebuilt to New Standards

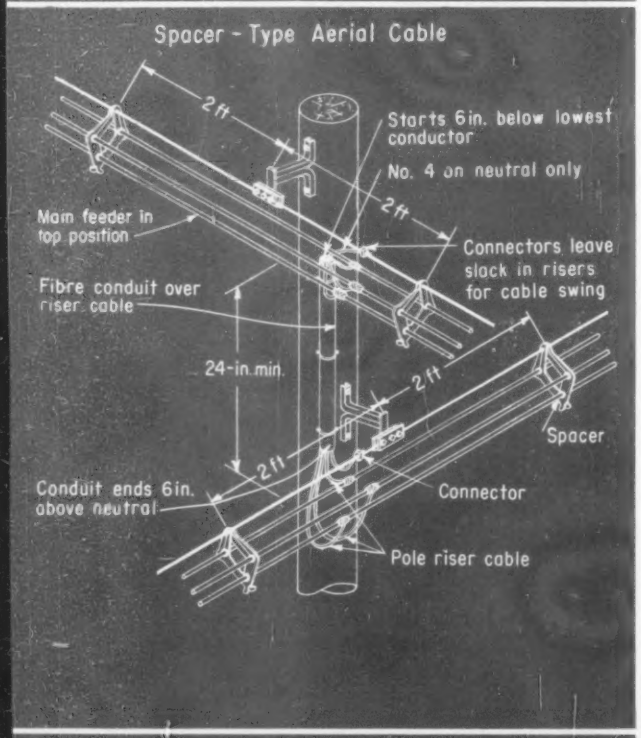
Concurrent with adoption of the new standards for new work, Public Service has been rebuilding existing open-wire plant to cable in storm-vulnerable areas on an annual-program basis. An early step is converting the street lights to multiple, thereby eliminating the customary No. 6 series conductor from top distribution crossarms. This small wire was usually the first to fail during storms, and as it fell it often faulted other conductors to cause service interruptions and damage.

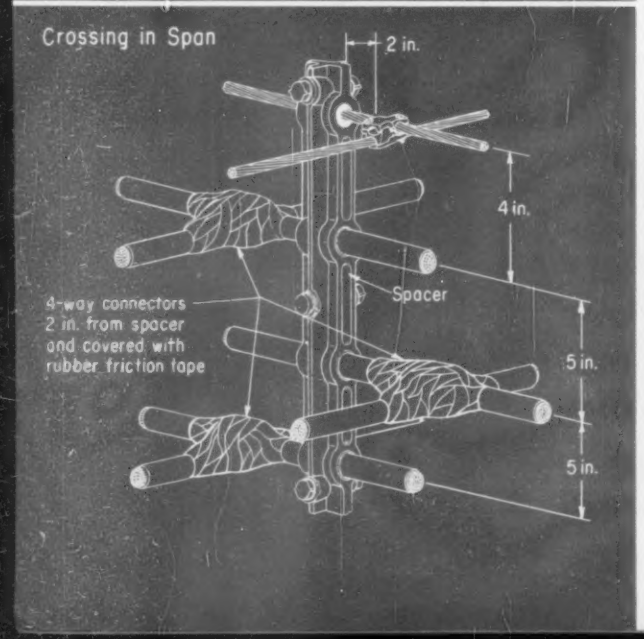
TRANSFORMER INSTALLATIONS specifiy cluster mounting for 3-phase, pole-mounting for 1-phase, with CSP units


Friction Tape Cable Hanger
Binding Secured with Connector.
Friction Tape
Insulated Connector
1-Spool Rack
No. 4 Copper Ground in ½-in. Plastic Molding to Secondary Neutral and Driven Ground
Secondary Lead Bracket
Cable Hangers


On Lashed And Spacer Cable
No. 4 Cu. to Neutral Bushing
Spacer Bracket on ⅝ in. Bolt
Neutral in Plastic Moulding
Insulated Connector
Riser
CSP Transformer
Friction Tape
Connect Messenger and Ground Wire
Clamp on ⅝ in. Bolt
Lashing Connector
Parallel Gutter Tapes (16-2575)
Solderless Connector on Neutral
No. 4 Cu Ground in ½-in. Plastic Moulding







Distribution for the Future

About 5 million feet of No. 6 wire has been removed in this program.

Space vacated by the series circuit is used to re-space remaining high-strength primary conductors to 24-in. minimum separation. Any existing polyphase conductor with badly worn covering or insufficient tensile strength is replaced with lashed or spacer cable of the same type as for new work. Single-phase conductor is relocated from the crossarm to a pole pin and, if this operation involves re-running the wire, it is replaced with high-strength tree wire. Thus crossarms have been eliminated from many poles, and excess height cut from the tops of some.

Secondary Spacing Improved

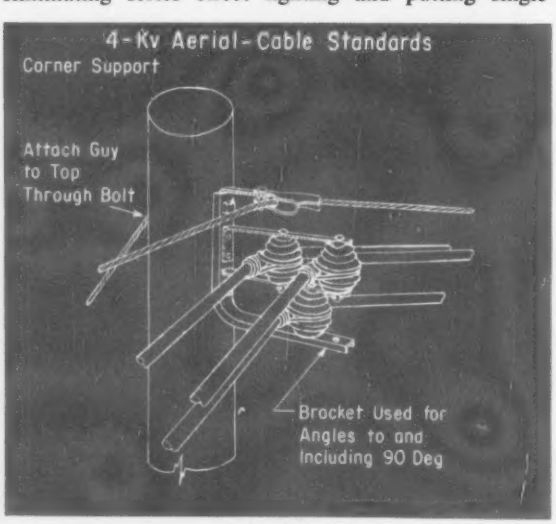
Existing secondaries suitable for continued use are given additional spacing by removing the neutral wherever a primary cable messenger can be used as a common neutral. Otherwise spacers are attached to the secondaries to maintain their customary separation. Secondary conductors which run on crossarms, or must be re-run for any reason, are replaced with aerial cable as specified for new work.

Application of all these changes to residential distribution has brought a marked improvement in appearance. Thus, while improved reliability and resistance to storm damage were the main objectives, there has been a gratifying "dividend" in customer approval of the shorter poles carrying cable instead of crossarms and open wires. The new construction is proving to be an acceptable substitute for the underground plant which is too frequently suggested by the uninformed.

Working conditions on distribution poles have been improved by the rebuilding. This should lessen the hazards normally associated with overhead line work and contribute to increased productivity as crews become accustomed to the new methods.

Overall Cost Comparable With Open Wire

Analysis of expenditures under the new aerial-cable program indicates that cabled secondaries are no more costly than conventional open-wire. Three-phase runs of primary cable cost more than equivalent open wire, but the composite of primary plant has benefited from eliminating series street lighting and putting single-


4-Kv Aerial-Cable Standards
Corner Support
Attach Guy to Top Through Bolt
Bracket Used for Angles to and Including 90 Deg

Distribution for the Future

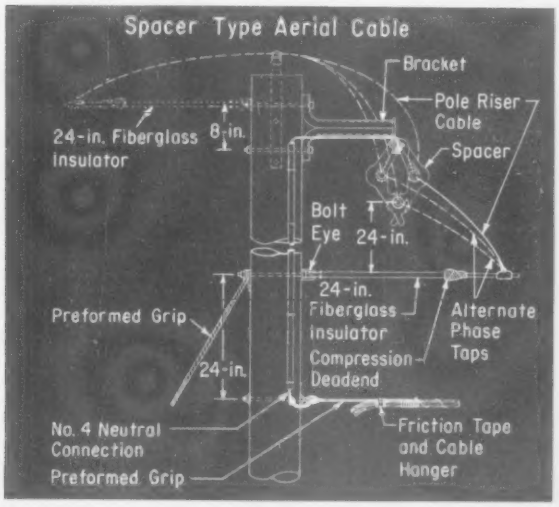
phase conductors on pole pins. Thus the overall cost differential seems to be about 3.3%. But additional compensating savings are anticipated in later years from reduced tree trimming, reduced maintenance, less damage and quicker restoration after storms, and from better voltage regulation with less need for shunt capacitors. It is entirely possible that these savings will offset the small premium presently indicated and show a net savings for the aerial-cable program.

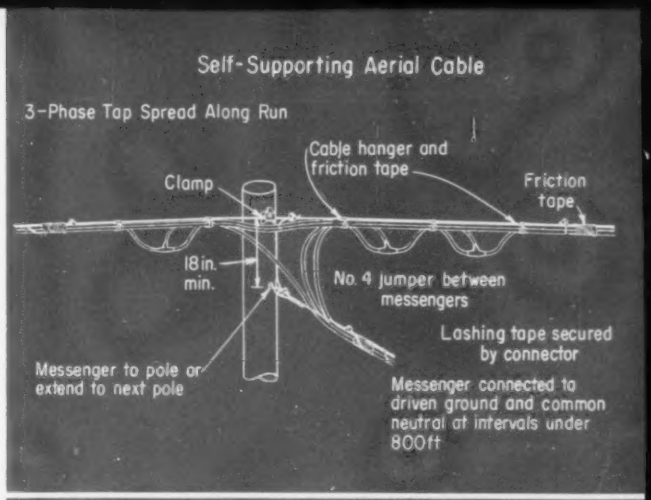
Transmission, Subtransmission Modified

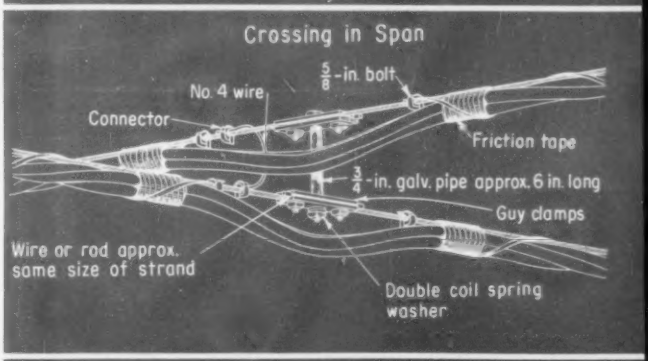
Transmission and subtransmission also came under review in this sweeping program. Crossings of transmission over other open-wire transmission or subtransmission are specifically discouraged as an obstacle to normal maintenance as well as to restoration after storms. And the specified ultimate strength of shield wires has been raised to 26,000 lb (9/16-in. Alumoweld or 7/16-in. stainless steel) instead of the 17,730-lb 190.8-MCM ACSR of previous standards. Shield wires will be supported by 12-ft crossarms instead of 30-ft to increase horizontal separation from phase conductors and to gain tower strength without sacrificing shielding effectiveness against lightning.

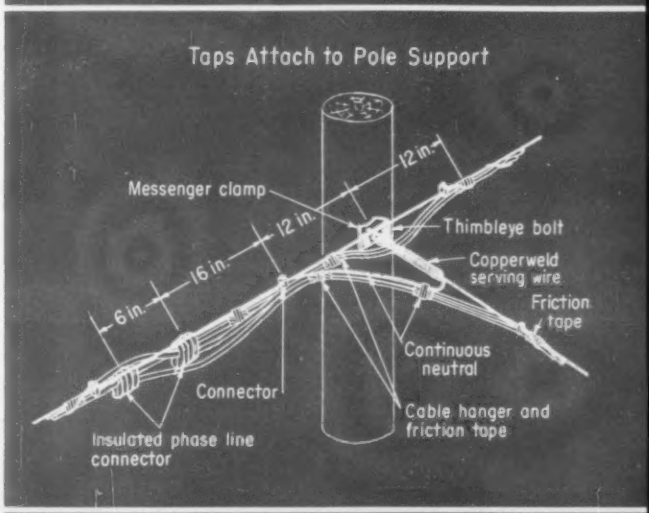
New and rebuilt subtransmission will equal or exceed NESC Grade B recommendations. Double arms, double braces, and double ridge pins will be used on all spans over 175 ft to a 250-ft maximum and on all guyed structures. Guys will be ⅜-in. or 7/16-in. (12,000 and 19,000 lb, respectively) attached close to the load centers and insulated where necessary with fibre-glass strain insulators. They will be terminated with preformed or served attachments, rather than 3-bolt clamps, and anchors will be de-rated below previous strength ratings.

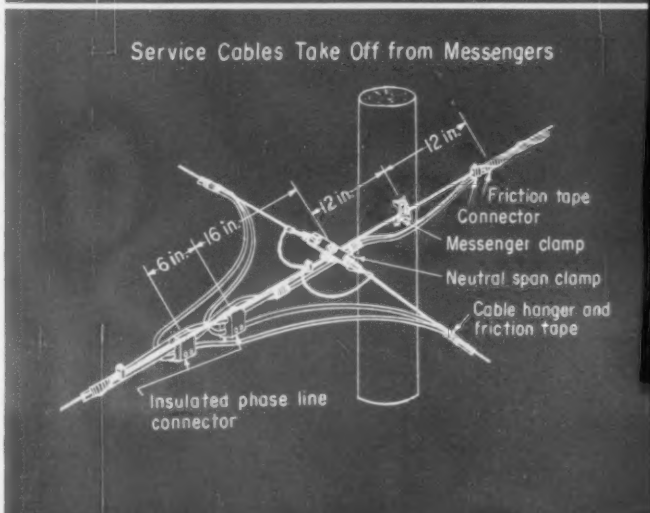
Subtransmission conductors will be No. 1/0 AAAC, 397.5 or 800-MCM bare aluminum, or the equivalent in copper. Tension will be limited to 2,000 lb for the two smaller sizes, 2,500 lb for 800-MCM aluminum and 500-MCM copper. Existing circuits of 500-MCM copper or 800-MCM aluminum are to be modified to the new standards as soon as practicable. Smaller circuits will be strengthened during line changes or reinforcements; otherwise conversion will be scheduled on a programmed basis.




Self-Supporting Aerial Cable
3-Phase Tap Spread Along Run
Cable hanger and friction tape
Clamp
Friction tape
18 in. min.
No. 4 jumper between messengers
Lashing tape secured by connector
Messenger to pole or extend to next pole
Messenger connected to driven ground and common neutral at intervals under 800ft







Suburb Puts Distribution Under

Tchefuncta Club Estates near New Orleans has buried cable, semi-buried units, cost agreement with Central Louisiana Electric

NEWTON HIMEL, Distribution Engineer, Central Louisiana Electric Co, Pineville, La.

Buried-cable distribution and semi-buried transformers will bring electric service to a new New Orleans suburban residential development. The builders and Central Louisiana Electric Co have agreed to put distribution to the Tchefuncta Club Estates, on the north side of Lake Ponchartrain from the city, under ground for the sake of appearance and more reliable service.

This project, along with others in Florida, Texas, and Maryland, intimates a possible trend toward underground distribution in new residential construction in the South.

The arrangement worked out between the subdivision's developers and the utility provides for a cash contribution by the subdivider to cover part of the investment cost for the distribution system and a guarantee by the developer that annual revenue from customers will equal a third of the balance of the investment outlay, the portion put up by Central Louisiana Electric. If the annual electric revenue falls below 33⅓% of the investment cost to the utility, Tchefuncta Club Estates will be billed for the difference on a non-refundable basis.

The distribution system was designed by Bedell & Nelson, Inc, consulting engineers, for serving 403 residences. The design was based on 100% saturation of air-conditioning or heat-pump loads, plus lighting, water heaters, ranges, and miscellaneous appliances. Easements, signed by the Tchefuncta Club before any lots were sold, provide for distribution facilities on rear-lot lines.

The design calls for a ground-type substation, consisting of three 167-kva, 13.8-2.4-kv, single-phase transformers, connected delta-grounded wye with provision for four 3-phase circuits. Primary voltage will be 2,400/4,160Y. This primary voltage will permit the use of unshielded cables and enclosed cutouts and eliminate expensive termination and additional clearances in the transformer housings. The 4,160-v system will afford better voltage regulation than that now available with a 2,400-v system.

The decision to go to 4,160 v was a departure from the primary distribution voltage in the area. But 13.2-kv was considered uneconomical for 3-phase underground circuits because of the need for shielded cables with their inherent requirements of expensive terminations, greater clearance in transformer housings, and open-type cutouts.

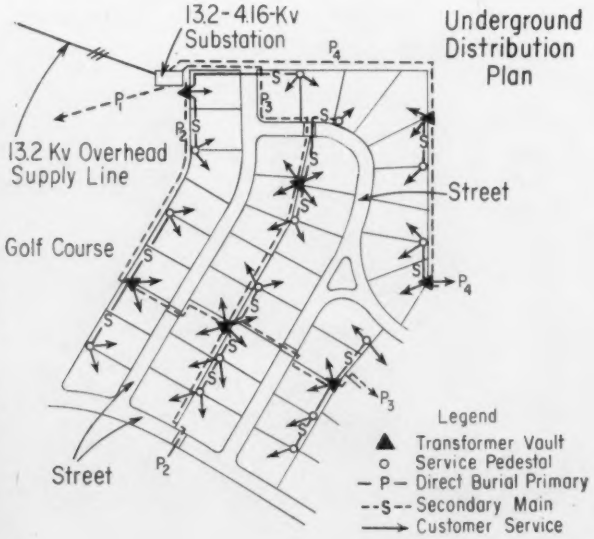
Trenches shared by primaries and secondaries are 6 in. wide and 42 in. deep, the primary cables being laid in the bottom. Such trenches are then partially backfilled, and the secondary cables and common bare neutral are laid 1 ft above the primary cables. Another partial backfill covers the secondaries and neutral, and 2 x 6-in. creosoted planks are laid over them for mechanical protection. A final backfill covers the planks.

Buried Cable Rubber-Neoprene

Primary cables are standard No. 2, 5-kv, single-conductor, stranded aluminum with 10/64 in. of ozone-resistant butyl rubber insulation and a 4/64-in. Neoprene jacket. They are the non-shielded, direct-burial type. All three phases are brought into each transformer housing, making 3-phase service universally available where needed.

Cables were sized to handled

TCHEFUNCTA CLUB ESTATES is encircled by Tchefuncta River. Golf course is near open area at left and street locations of first development are adjacent (white circle)



Ground

loads well into the future, both thermally and from the voltage-regulation standpoint. Some express runs of feeders may be necessary later when load approaches the ultimate. These will break loads into smaller segments to minimize the extent and duration of service interruptions. Primary-tie circuits are being installed to permit an alternate feed to any location.

Transformer housings were made of 18-gage galvanized iron, two cylindrical sections joined to permit free circulation of air for transformer cooling. The housings are 5 ft in dia and 42 in. high. Their bottom sections were coated with an asphaltic base compound and buried 18 to 20 in.

Covers for the housings were attached to the top sections and padlocked to a ground rod protruding through the center. A shoulder welded to the ground rod adds physical bracing for the cover. The ground rod is a 1-in. galvanized pipe 15 ft long. Joints were tack-welded to the pipe to prevent the pipes from unscrewing. The padlock goes through a ⅜-in. hole ½ in. from the top of the ground rod.

A ⅜-in. steel nut was welded inside of the bottom section of the housing, flat side nut out. This nut grounds the housing to the system ground. A ½-in. lifting eye and nut, welded to the cover 2½ in. from the center, makes handling the cover easier.

Line Transformers Used

Standard overhead-type, single-phase, 2,400/120-240-v distribution transformers, with sidewall bushings and internal protective links, were set on concrete blocks inside the housings to keep them off the ground. No lightning arresters were installed, the system being entirely underground.

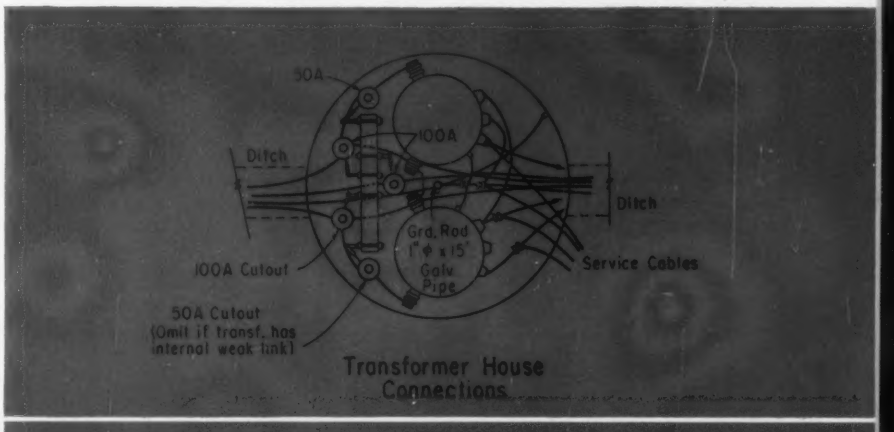
Load-break type cutouts were installed as transformer disconnect switches and for sectionalizing the primary feeders.

Secondaries are No. 3/0 stranded aluminum conductor, type RHW, 600-v, with $\frac{6}{64}$-in. rubber insulation and $\frac{4}{64}$-in. neoprene jacket.

Due to the close spacing of cables and short secondary runs, voltage

TRANSFORMER INSTALLATION consists of standard overhead, single-phase unit with sidewall bushings, internal protective links, and set on concrete blocks

STEEL ENCLOSURE provides space for line-type transformer, disconnecting load-break cutouts, and access to both primary and secondary cable systems



Transformer House Connections

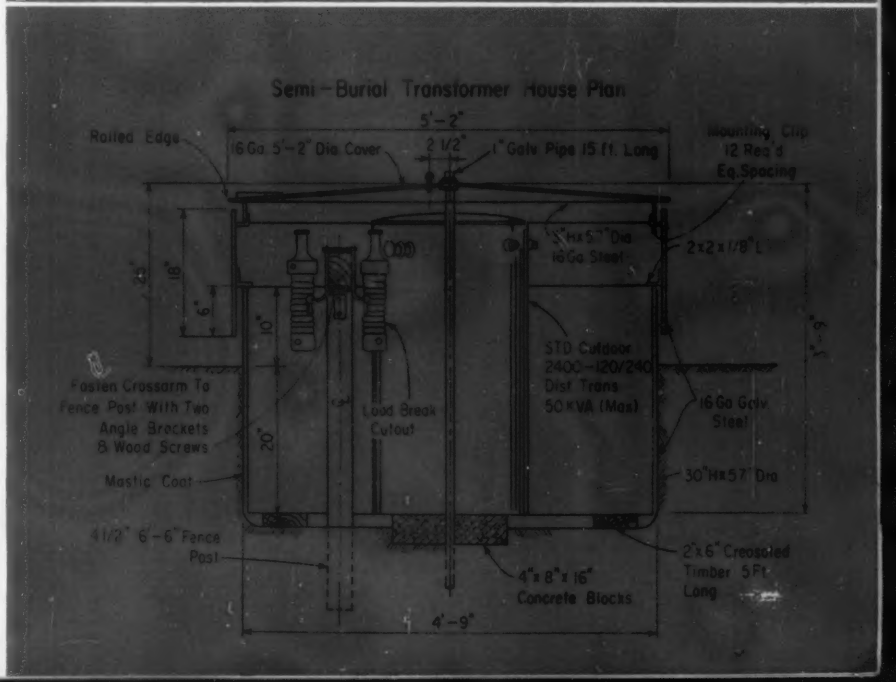


Table I—Summary Underground System

Units	Installed Cost
500-kva, 13.8/4.16-kv Substation	$ 7,670
5 kv, 3-phase, 4-wire primaries	68,790
Primary feeder tie circuits	3,380
Distribution transformer housings	7,440
120/240 v, 3-phase, 4-wire secondaries	25,940
Service Pedestals	4,180
Sub Total	117,400
Contingencies at 10%	11,740
Engineering fee at 6% (Includes Consultant's Fee)	7,750
Total less distribution transformers	136,890
Distribution transformers to serve half ultimate customers at light load	11,840
Total cost to serve initial load (underground)	148,730

Table II—Summary Overhead System

Units	Installed Cost*
13.8 kv ACSR Primaries	$ 8,580
Poles	14,610
Guys, Anchors, etc	7,390
Framing	8,110
120/240 v, 3-phase, 4-wire secondaries	15,270
Sub Total	53,960
Contingencies at 10%	5,400
Total less distribution transformers	59,360
Distribution Transformers, Cutouts, and Arresters to serve half ultimate customers at light loads	22,230
Total cost to serve initial load (Overhead)	81,590

* Includes 5% Engineering costs

drops and flicker voltage caused by motor starting will be less than those on overhead construction.

Service pedestals at lot junctions each serve four lots. Service cables, purchased and installed by customers, were connected at the pedestals by the utility.

The service pedestal is two sections of 5-in. dia by 24-in. galvanized steel pipe joined by a coupling at the ground line. The pedestal tops were covered with standard pipe caps and T&B No. 233 bushings were installed on the bottom. Welded to the pedestal at right angles, 4 in. from the bottom, are three 18-in. lengths of 1-in. pipe projecting radially around the pedestal. The pipes give holding power in the ground, and the system ground is connected to them.

As the system is being installed in parts and the project not yet completed, actual cost figures are not available. Estimated costs of the underground system are shown in the tables.

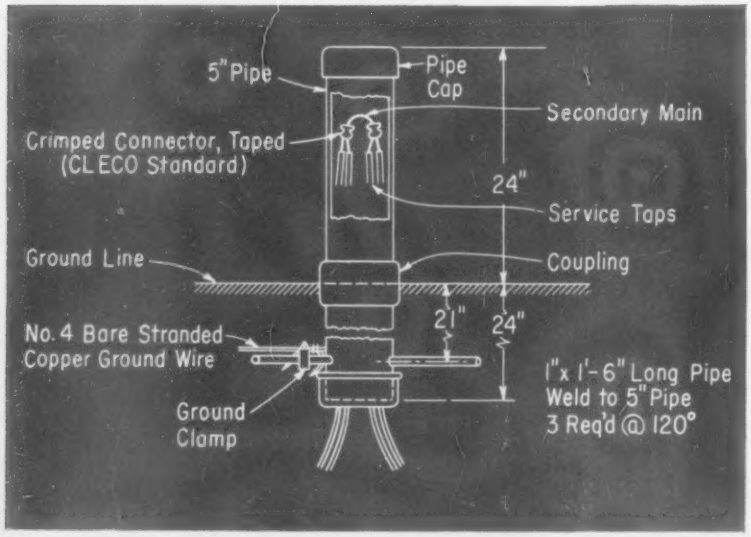
In the financial arrangement, it was estimated that when 100 customers have been connected the annual revenue will equal 33⅓% of the utility company's investment. After 100 customers have been connected, Central Louisiana Electric will begin refunding Tchefuncta Club Estates for the cash advanced for electric facilities. These refunds will be made as follows:

- First 100 new service connections, no refund.
- Next 50 new service connections, $900 for each all-electric home, or $700 for all other residences.
- All additional new service connections $500 for each all-electric home, or $300 for all other types.
- For any new service connection other than residential (water pumping, sewer pumping, etc.,) an estimated three times annual gross electric revenue.
- For any new service connected along the approach line $100.

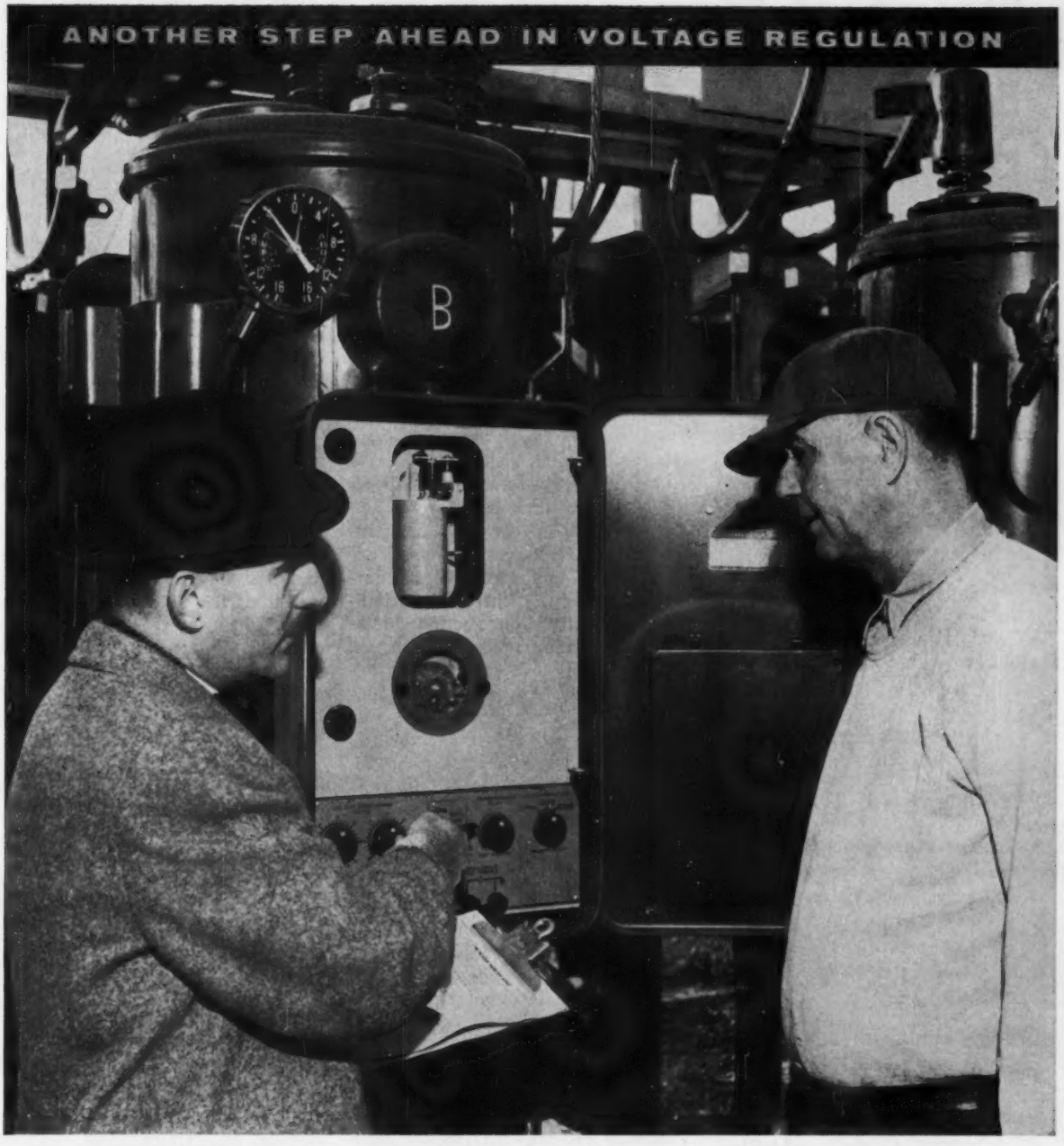
This agreement is for 10 years. After that time Central Louisiana Electric will make no further refunds, and Tchefuncta will not be obligated to pay any guaranteed revenue.

The cost ratio of the underground system compared to an equivalent overhead system serving 403 residences in the Tchefuncta Club Estates is about 1.82:1, including primary feeder emergency tie circuits, and a reasonable number of transformers for additional load.

Both Tchefuncta Club Estates and Central Louisiana Electric feel that the improved appearance and service reliability justify the added expense.



SERVICE PEDESTAL houses cable taps from the buried secondary mains



WITH GENERAL ELECTRIC VOLTAGE REGULATORS:

Installation inspection always free!

From the moment a General Electric voltage regulator is shipped, field service specialists of G.E.'s Installation and Service Engineering Department are available on a no-charge basis to provide a variety of initial installation inspection services. These services — embracing 18 specific areas—include inspection of new regulators, setting up productive maintenance programs, and training of customer personnel in the operation and maintenance of regulators.

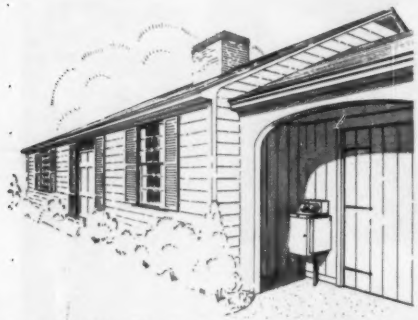
Available through your nearest G-E sales office, these specialists work effectively with General Electric product design engineers on the one hand, and application engineers on the other to provide *the most extensive regulator field service in the industry.*

When you buy General Electric voltage regulators, you are making a TOTAL VALUE investment—of which installation inspection is just one of the dividends. *Voltage Regulator Products Section, Pittsfield, Mass.* 456-07

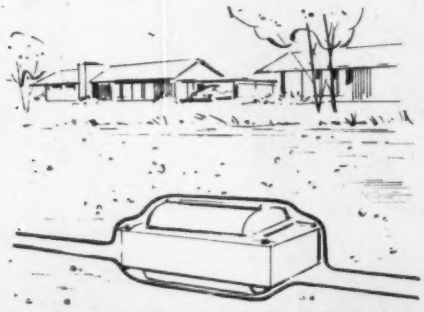
Progress Is Our Most Important Product

GENERAL ELECTRIC

Encapsulated Transformer Projects Disclosed by Industry



Current GE-utility test trials are directed toward "unit-residential package" applications



Future potential applications will include direct burying of the encapsulated unit . . .

Small pad-mountings will be tested . . .

"Encapsulates" in modern high-rise apartment buildings are also being planned.

The electrical industry's long-time covert search for a dry distribution transformer was brought out into the open last week when General Electric Co's Distribution Transformer Department announced the availability of resin-encapsulated transformers in limited numbers for field trial installation by utilities.

Following closely on the heels of GE's announcement, other transformer manufacturers told *Electrical World* of their development and test projects on encapsulated units. Nine manufacturers described development and test projects currently underway; three others indicated that basic engineering studies are now being made. All agreed on the need for, and on the advantages to be gained with, "encapsulates." Differences arose pertinent to the best location for, and to the economics of, the encapsulated units.

The GE encapsulated transformers are in ratings of 15 and 25 kva for all primary voltages up to 13.2 kv grounded wye. The design uses no cellulosic insulating materials. Both the primary and secondary windings are encased in a special high thermal capacity epoxy resin.

The units are rated at 80C average winding temperature rise, and have a dielectric and impulse strength that equals that of conventional oil-filled construction. This has been accomplished by vacuum treating and impregnating the high-voltage winding with a small amount of oil (less than 1 pt in a 25 kva unit), after encapsulation is completed. The secondary winding is not so impregnated, it was noted.

Encapsulation of the unit is accomplished with a specially-developed epoxy resin formulation in which finely divided silica is used to increase heat transfer characteristics. Heat transfer is further aided by air ducts through the coil structure. The design of the core itself also helps to radiate heat generated in the windings. All solid materials

GE'S NEW 15-KVA resin-encapsulated transformer weighs 25% less, is 25% smaller, and requires 40-50% less volume than its oil-filled counterpart

used are said to work well above Class A temperature limits. In this special environment the oil also operates satisfactorily, it was noted.

Omission of the tank oil and bushings have reduced size and weight of the design. The 25 kva unit, for instance, weighs 340 lb (26% less than an oil insulated one); floor space is 13 x 18 in. or 57% less; and, the unit stands 27 in. high, which is 37% shorter than an oil-filled one.

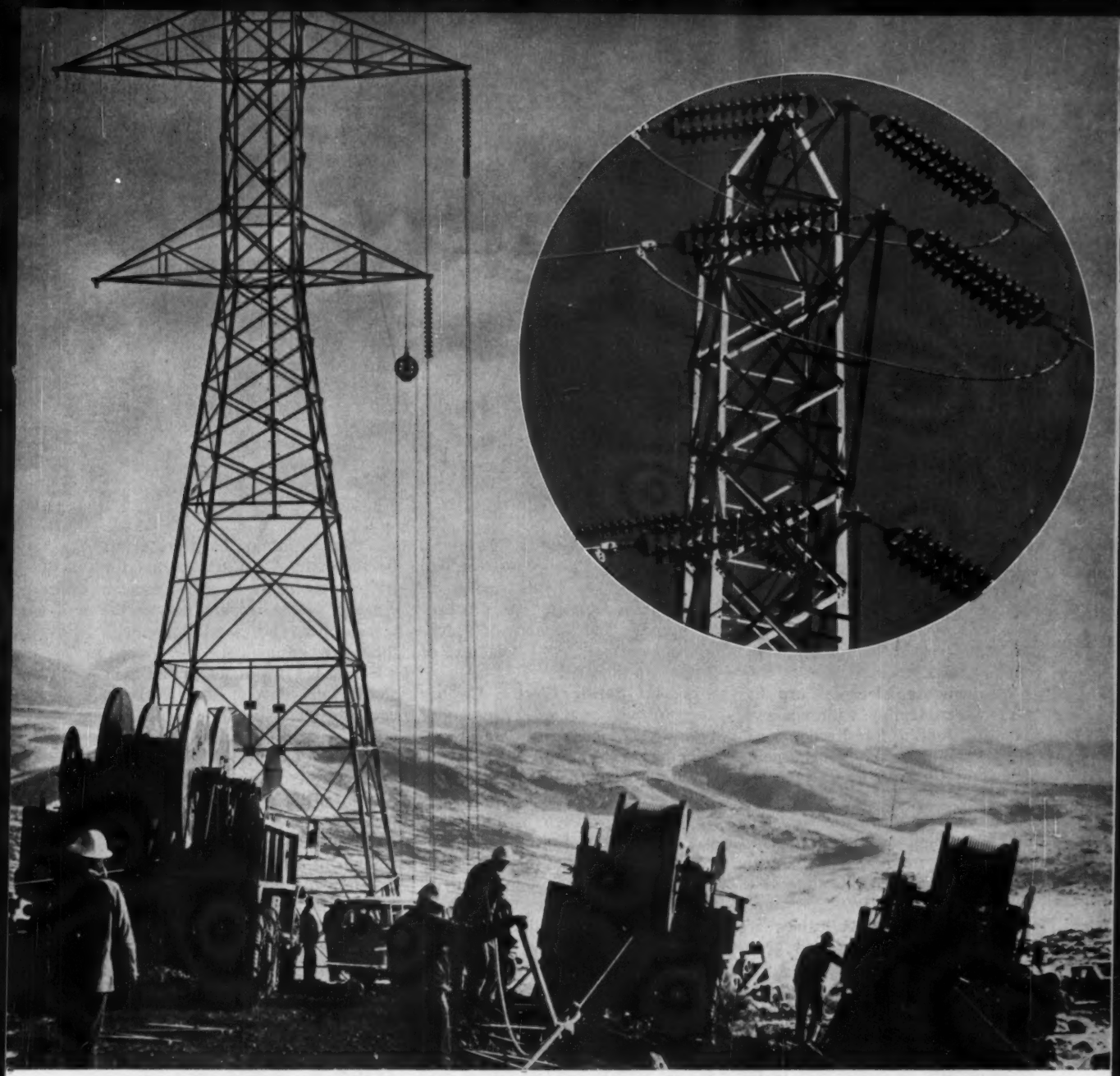
General Electric spokesmen said that 50 to 100 of the new units will be made available to utilities this year, at a slight price premium above conventional units, to gather field experience—particularly with reference to the pros and cons of the one-transformer-per-residence concept. An early application of the new encapsulated transformers will be, they said, in a "unit residential" package suitable for mounting on the outside wall of a house or garage. The package will house the transformer and accessories, including load break disconnect switches and meters.

During the next few years GE representatives said that trial tests will include direct burial of the unit, industrial applications in mines, use in high-rise apartment buildings, small pad-mounted installations and replacements for conventional oil-type pole-top transformers.

Others Working on 'Encapsulates'

• **Pennsylvania Transformer Division's** (M-E Co) recent dry-type prototype distribution transformers consist of a core-and-oil assembly,

(*Continued on page* 68)



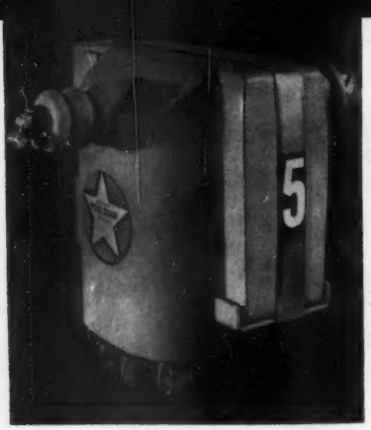
Idaho Power's section of 230KV line from Oxbow to Lewiston, Idaho during construction. Insert shows completed tower.

VICTOR SUSPENSIONS USED BY IDAHO POWER

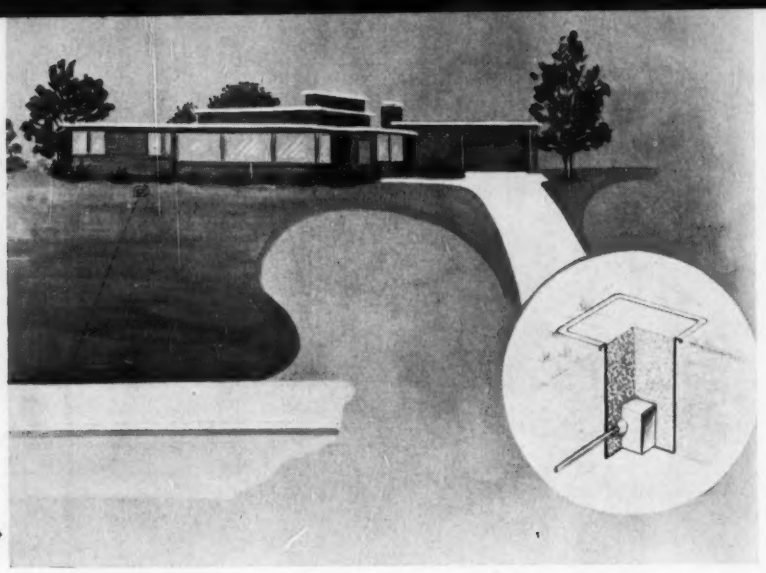
Where the terrain is rough . . . where insulator replacement is even rougher, VICTOR 10" Suspensions are the answer to continuity of service. Take Idaho Power's section of the Oxbow-Lewiston 230KV line shown under construction above. Located on the Snake River in the Hells Canyon area, this 66-mile line crosses one of the most inaccessible parts of the Northwest. Insulators are put up to stay up. Because of VICTOR Purified Porcelain, quality manufacturing control, and electrical and mechanical laboratory testing, they have proved their ability to far exceed their EEI-NEMA ratings. That means when you buy VICTOR Suspensions, you buy dependable, trouble-free service.

Write Victor Insulators Division, I-T-E Circuit Breaker Company, Victor, N. Y. for full information and engineering specifications on Victor Suspensions.

I-T-E CIRCUIT BREAKER COMPANY



BUSHINGS of Penn Transformer's 5-kva "encapsulate" unit are cast in place



WESTINGHOUSE to bury "encapsulate" in sand to solve heat problem

encapsulated in modified epoxy. Tests conducted to date include impulse, heat cycling, and weather exposure. Operational data obtained over a two-year period is now being studied in preparation for initial production models.

• **Westinghouse Electric Corp** has been experimenting with encapsulated distribution transformers since 1954. A unit currently undergoing test is a dry type transformer for single, residence installation.

The installation requires an open tank with the top set just at the surface of the ground. The relatively small transformer (about the size of a brief-case), is placed in the tank. High and low voltage cables are connected through sealed connectors in a grounded sheath.

The open tank is then filled with the thermal sand. The power supply is safe and completely out of sight. The installation can be water cooled economically by connection to the house water supply. It has tremendous heat absorbing ability and can carry extreme peaks of load.

• **Standard Transformer Co** has manufactured encapsulated instrument transformers up to 5 kv for years, and encapsulated distribution transformers up to 15 kva, but limited to 600-v primaries.

The availability of higher quality resins with better dielectric and thermal characteristics has caused Standard to engage in research toward extending ratings in both these areas. They feel they could today produce 5-kv distribution transformers but are dubious on the economics, especially in view of the added emphasis placed on overload capacity and low losses by utilities.

But resin technology is proceeding rapidly, and Standard is watching and working with a great deal of interest in this area.

• **Federal Pacific Electric Co** has been working on the development of an epoxy encapsulated line of distribution transformers since 1957. Progress in this field has developed to the point where prototype models have not only been manufactured but are already being tested in several of their facilities throughout the country. During 1961 FPE Co intend to expand this program further and make available the transformers to various utility systems for testing.

• **Line Material Ind** (M-E Co) has been developing encapsulated overhead-type distribution transformers for six years. Field trial units, in several voltage and kva ratings, will be installed within 30 days.

• **R E Uptegraff Mfg Co** is currently working on 5 through 15-kva encapsulated distribution transformers units, but feels that cooling of the larger size units presents economical limitations.

• **Allis-Chalmers Mfg Co,** with a stated "record of more epoxy transformers produced than the rest of the industry combined", feel that the ultimate solution to the overhead distribution problem will be direct burial of the distribution system including the encapsulated transformer. Several such A-C trial installations have been made in the last three years and have proven to be successful. A-C states that the biggest problems to be overcome concern proper terminations at the transformer, and coordination with the related equipment.

• **R T & E Corp** indicates that their studies and development work on encapsulates distribution transformers have been aided by new materials and improved methods of applying these new materials to the making of the new type distribution transformers. R T & E feels that the encapsulated unit is the future development direction in the distribution transformer industry.

• **Moloney Electric Co** encapsulated distribution transformer core-and-coil units in 1959. These units installed underground and connected for a continuous bucking heat run, have now completed more than a year of operation. Moloney recently joined with several utility companies located in various parts of the country in encapsulation transformer studies and experimental programs. These experimental programs are directed toward finding the answers pertaining to installation costs, methods of application, and proper designs for the various types of systems.

The first wall-mounted encapsulated distribution transformer is now being manufactured and is scheduled for installation early this year on the system of an eastern utility.

EW will keep close tabs on "encapsulates" development, including activities of utilities, and will report same when available.

Communication Cable
that cuts installation time

in half!

SUPERIOR

I.M. CABLE

Cable messenger is firmly gripped between jaws of Tangent Support

- **Needs no separate messenger**
- **Requires no special hardware**

When you install SUPERIOR I. M. Cable, the need for spinning or supporting the cable to a separate messenger is completely eliminated!

Choose the core construction you need with color-coded plastic insulated conductors and longitudinally applied corrugated aluminum or copper shielding over the core tape . . . sizes 6, 12, 18, 25, 50, 75 and 100 pairs in 22, 19, and 16 gauge soft-drawn copper. Cable exceeds current industry specifications.

The messenger is impregnated with a corrosion-proofing thermoplastic compound which becomes an integral part of the cable configuration during the jacketing operation. Breaking strength exceeds 6000 pounds. Can be gripped, pulled and tensioned using standard techniques.

A high molecular weight polyethylene jacket is extruded over both core and messenger.

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Internal Ruggedness..

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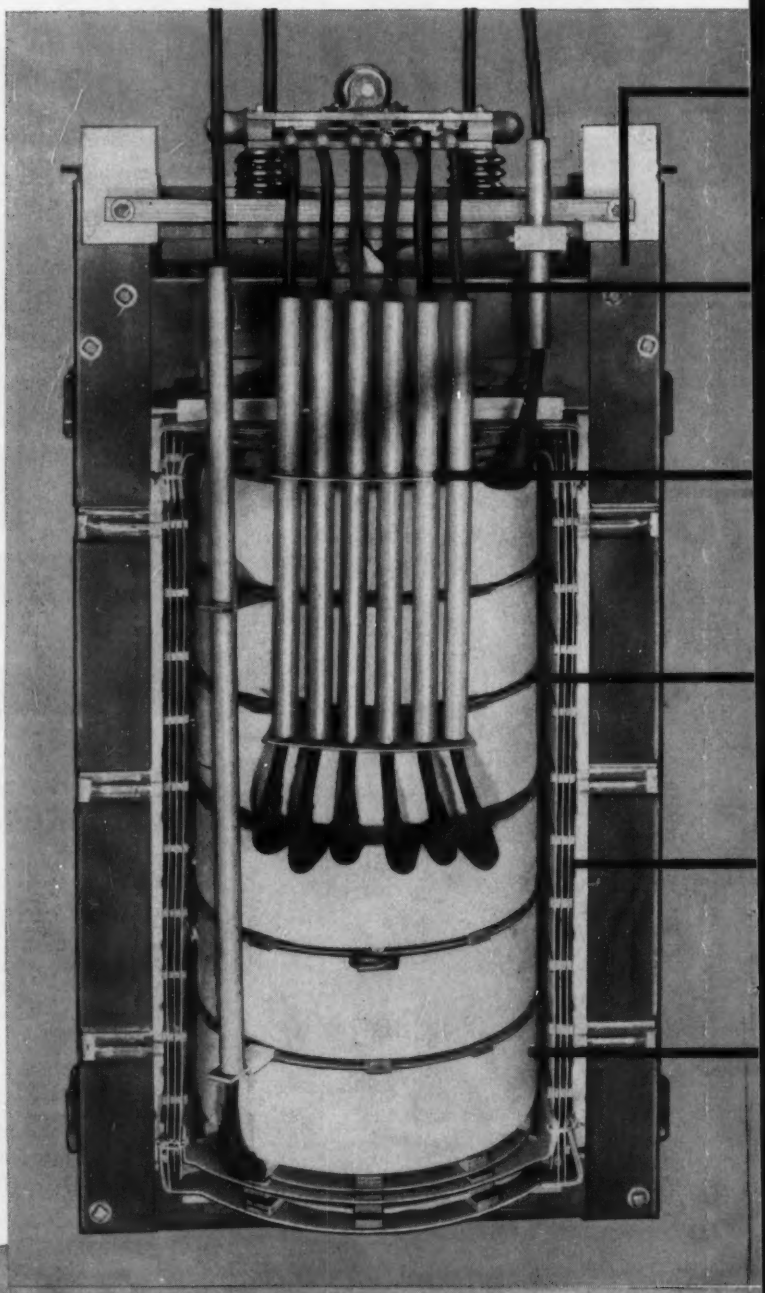


As a general rule, the higher the voltage, the more essential it is that transformer service be continuous and trouble-free. This is true from the standpoint of economics as well as that of customer satisfaction . . . and it is why Pennsylvania gives you *extra* ruggedness where it counts the most, in high voltage Pole Stars.

Take a look at the interior design features shown on these pages and see for yourself. From the patented lap-on-top core to little noticed lead supports, Pole Stars are designed and constructed to deliver *sustained performance* in every type of transformer installation. You can rely on Pole Stars for long range economy and dependability throughout the complete range of EEI-NEMA ratings: through 500 kva, through 67,000 volts, single phase. Pennsylvania Transformer Division, McGraw-Edison Co., Canonsburg, Pa.

The unit pictured is 500 kva. High voltage: 67,000 volts. Low voltage: 7560/13,090Y volts. Construction features shown may vary somewhat in other voltage classes.

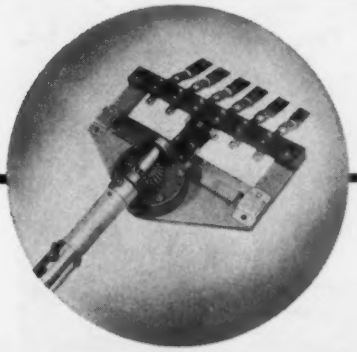
McGRAW EDISON

PENNSYLVANIA TRANSFORMERS

PENNSYLVANIA

key to sustained performance of high voltage

TRANSFORMERS



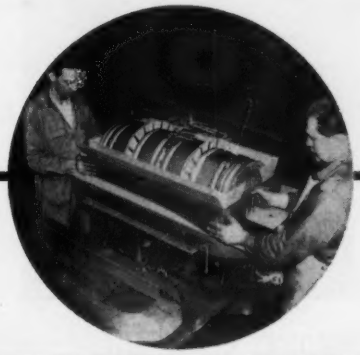
ANGLE-AND-CHANNEL CORE FRAME

Core-and-coil assembly is supported by a sturdy, pressed steel, angle-and-channel frame, which is securely fastened together by bolts with permanently positioned nuts.

STRAIGHT-LINE TAP CHANGER

Straight-line tap changer is of same rugged design as that featured for years on Pennsylvania Power Transformers. Sintered silver-nickel contacts possess electrical qualities of silver and wearing characteristics of nickel.

INTEGRAL LEAD SUPPORTS

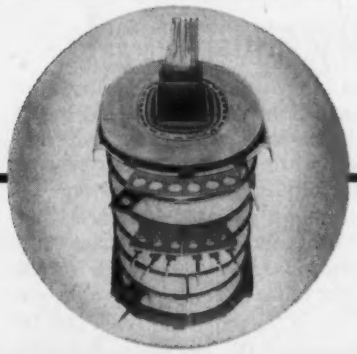


High voltage leads are insulated in pressboard tubing and held firmly in position by supports that are an integral part of the coil.

LAP-ON-TOP CORE

Core features Pennsylvania's patented lap-on-top construction. Laminations are individually lapped, creating a large cross-section area at lap that reduces density and prevents concentration of flux. Absence of gaps or butt joints assures low exciting current.

INSULATION AND BRACING

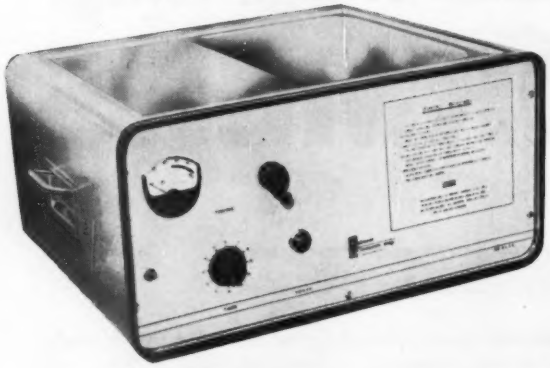


Coils are "packed out" with insulation to securely lock core and coil together. Maple braces provide extra support at top and bottom and help to protect against possible short circuit forces.

SECTIONAL COIL

High voltage windings are sectional, with low voltage layer windings inside. Use of sectional coils in higher voltages improves insulation . . . permits weight and size reductions. Also results in uniform distribution of impulse voltage and greater resistance to short circuit.

DISTRIBUTION TRANSFORMERS



Ultrasonic Cleaner . . .

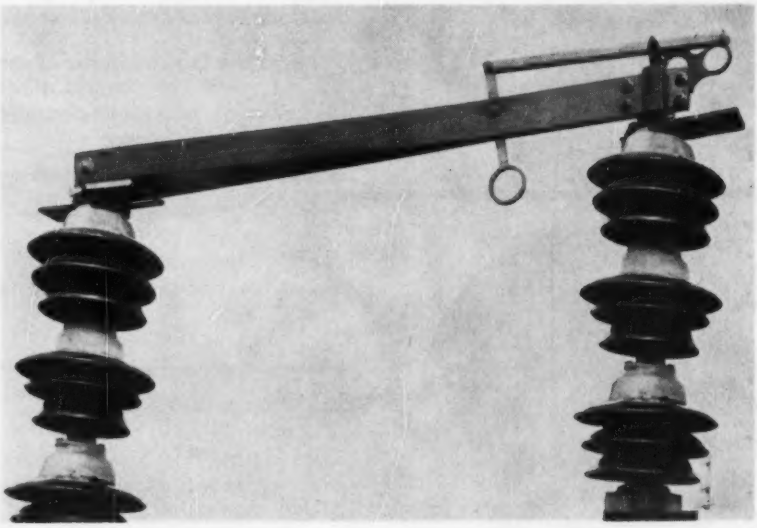
. . . is self-contained, with both generator and cleaning tank housed in a one-piece, polished stainless steel wrap-around cabinet. Model 940 has a minimum number of controls: an on-off switch for continuous operation; a timer for 0-15 min operation with automatic shutoff; and a tuning knob and meter. Input voltage is 115 or 230, input current is 6 or 3 amp, and capacity is 3 gal. Generator capacity is 250 w average, 1,000 w peak, with a single tube, a half-wave self-rectifying oscillator circuit.

National Ultrasonic Corp, 111 Montgomery Ave, Irvington 11, N. J.

Hook-Stick Switch

. . . to handle high capacity ratings is designed primarily for circuit breaker applications. Available in all ratings, the Royal Type BT disconnect switch is mounted on two stacks of insulators and incorporates a positive blade latch on the front and back hinge contact. A newly designed linkage is operated from the bottom. The 138-kv, 1,600-amp design is shown here.

Royal Electric Mfg Co, Inc, 1122 E 87 St, Chicago 19, Ill.



Surface Safety Finish . . .

. . . brushes or rolls on to provide anti-slip surfaces for wood, metal, cement and floor tile. RUFFIN is based on Thiokol polysulfide modified epoxy on which fine or coarse abrasive grains are sprinkled. It is recommended particularly for oily or slick surfaces exposed to the weather: floors, ramps, elevated walkways, and stair treads. For use on expanded metal gratings, ladders, and similar applications, the abrasive is mixed using a vehicle to prevent waste of grains. The adhesive is laid down approximately 10 mil thick and can be sprinkled on at a rate of 25 lb per 100 sq ft. It comes in standard quantities to cover 150 and 1,600 sq ft.

Custom Abrasive Products Co, 373 W State St, Trenton, N. J.

(*More New Equipment on page* 74)

ALLIS-CHALMERS

ORIGINATORS OF 5/8% STEP REGULATORS

Insist on complete UNIT CONSTRUCTION to speed untanking...

bring maintenance out into the open

Unit construction of the JFR regulator simplifies untanking — brings all components and connections into full view! You make *all* internal inspections without breaking any electrical or mechanical connection. And you can *operate* the regulator for testing while the unit is untanked.

More JFR maintenance cost-cutting features: Oil sight gauge lets you check oil level at a glance. Unidirectional breather removes moisture and gases formed during tap changes. Quick-break mechanism is simple, rugged with a minimum number of moving parts for long, maintenance-free life. Externally-mounted by-pass arrester offers positive, visual proof of series winding protection.

Should you need a regulator replacement part — A-C maintains nationwide stocks. *Specify* **Allis-Chalmers** *Regulators . . . call, write or wire your nearby A-C office.*

Caliband is an Allis-Chalmers trademark.

A-1419

Exclusive CALIBAND control cuts control-setting time without changing customer voltage or line-drop compensator settings.

LABORATORY CONTROLLED...

Crapo

GALVANIZED STEEL STRAND FOR GUY, MESSENGER and OVERHEAD GROUND WIRE

The high, uniform, consistently-dependable quality of Crapo Galvanized Steel Strand is the direct result of close laboratory control over each step in manufacture. All wires used in forming a particular size and grade are produced from steel of selected analysis, carefully processed under technical supervision and stranded on precision machines. Both wire and finished strand are subjected to prescribed laboratory tests to insure the desired end result.

Heavy, uniform, tightly-bonded zinc coatings, applied by the famous Crapo Galvanizing Process, provide maximum resistance to corrosion.

Write for booklet OG-25 containing "Sag and Tension Data for Overhead Ground Wire."

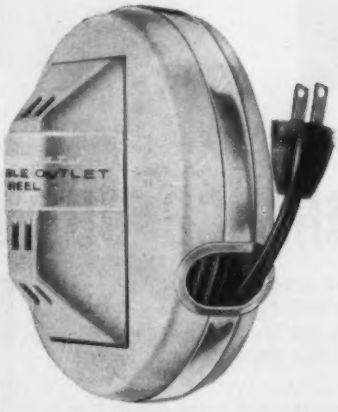
INDIANA

STEEL & WIRE CO., INC., Muncie, Indiana

Portable Drill Grinder . . .

. . . **chucks quickly onto any small portable electric drill,** and is said to sharpen them accurately in a matter of seconds. Port-A-Point Drill Grinder is equipped with a steel or optional carbide grinding wheel designed with a flip-flop drill-holding device that is claimed to offer greater simplicity in use. No table or bench setup is required and the grinder is manually held. Repoints masonry drills and steel twist drills up to ½-in. dia, also sharpens punches, chisels and screwdrivers.

SWG Corp, 903 Wrightwood Ave, Chicago 14, Ill.



Outlet Reel . . .

. . . **is portable** and provides 3-way outlets for plants, shops, warehouses or offices. Model 600-PO has automatically retracting reel for safety and to protect wiring. Cord pulls out to any length up to 15 ft, locks, and automatically retracts into housing when not in use. Heavy-duty spring motor is dustproof and lifetime-lubricated. Complete unit is U.L. approved.

Cordomatic Corp, Department P, 17th & Indiana Ave, Philadelphia, Pa.

Tool Stand . . .

. . . **features four drawers,** individually-locked, with sliding trays. The unit is mounted on 5-in swivel, composition rubber wheels, is 22½x20½ in. with a height of 34 in., and has 21¾x 20x6¾-in., recessed-handle drawers. Heavy duty top may be reversed to provide working tray with ½-in flange.

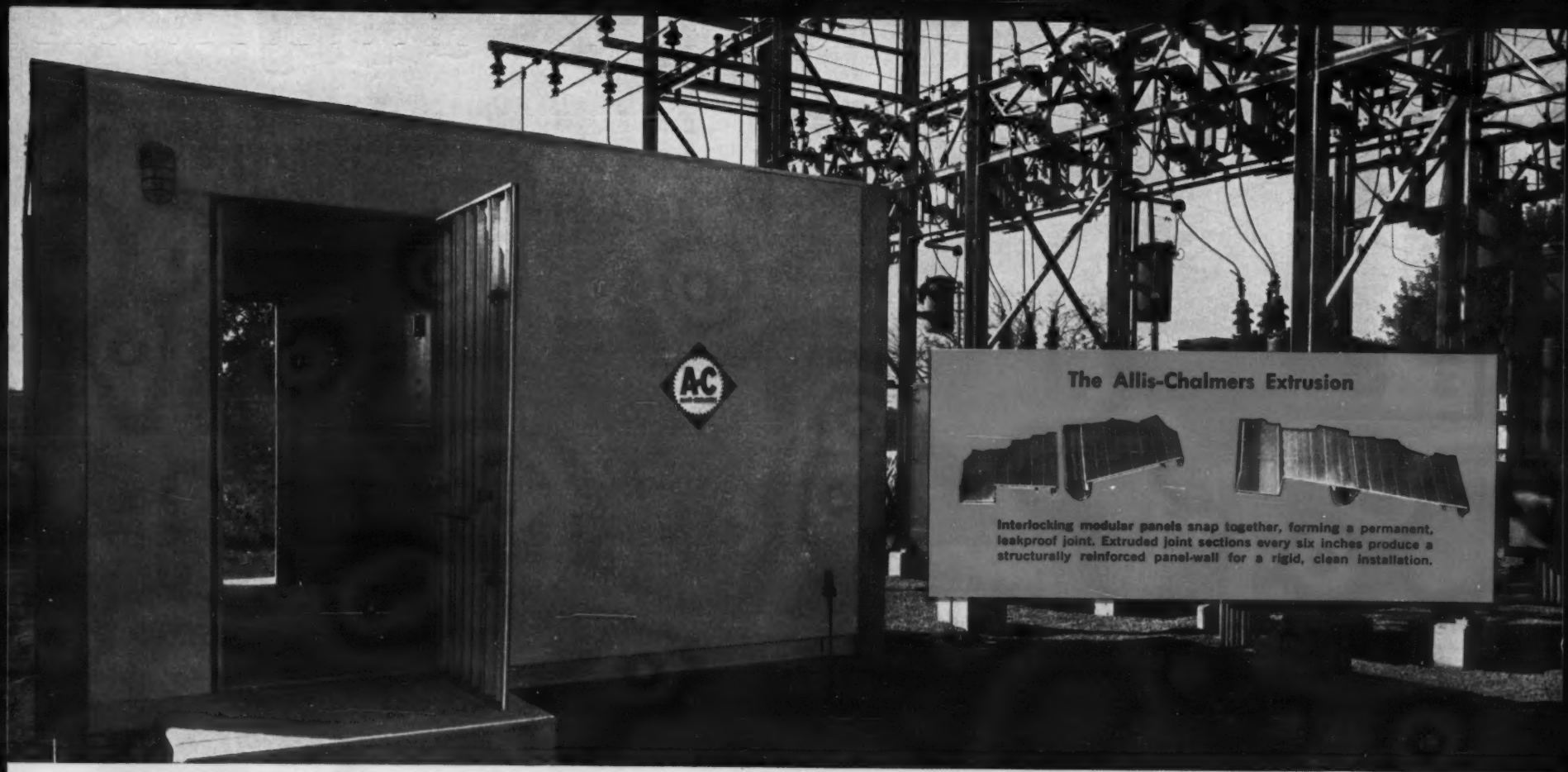
Lyon Metal Products, Inc, 11 Plant Ave, Aurora, Ill.

Work Glove . . .

. . . **combines warmth with long wear** for outdoor work. Tuf-Duk is made of impregnating, warm, fleecy jersey with tough, non-slip vinyl. The palm is heavily impregnated and the back is lightly impregnated to resist scuffing but let the hand breathe. This new process makes the glove oil and water repellent, yet retains the comfort of ordinary jersey. The specially compounded vinyl stays flexible even at low temperatures. Its wing-thumb pattern provides excellent fit and dexterity. Glove is available through safety and industrial distributors in knitwrist, slip-on and safety cuff styles.

Edmont, Inc, Coshocton, Ohio

(*More New Equipment, p* 76)


The Allis-Chalmers Extrusion
Interlocking modular panels snap together, forming a permanent, leakproof joint. Extruded joint sections every six inches produce a structurally reinforced panel-wall for a rigid, clean installation.

A new metal for switchgear housings!

NATIONAL ELECTRICAL WEEK
FEBRUARY 5-11, 1961

Allis-Chalmers *aluminum* switchgear housings offer:

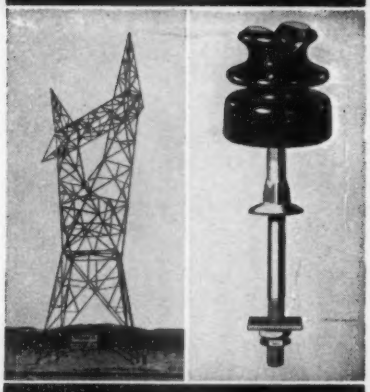
- easy installation
- attractive appearance
- corrosion resistance
- lower maintenance

For more details on aluminum housings . . . or steel, contact your nearby A-C office or write **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.*

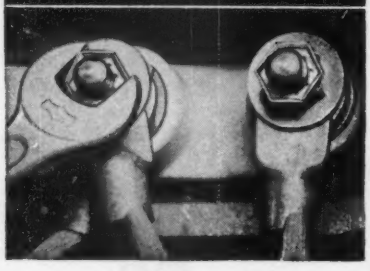
ALLIS-CHALMERS

A-1407

Assemblies stay tight!



Connections stay tight!



—when locked with

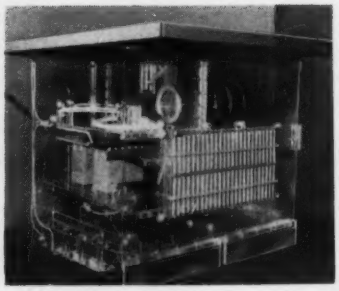
PALNUT LOCK NUTS

FOR years, PALNUTS have been the standard lock nuts of the utility industry—on steel towers, wood pole hardware, connectors, disconnects, switches, fittings, transformers, etc. Here's why: PALNUT Lock Nuts stay tight under severest vibration, are very low in cost, apply fast and easily, require little space. Available in full range of sizes, in plain, Parkerized and Hot Dip Galvanized steel; also silicon bronze.

Samples and Literature on request

THE PALNUT COMPANY
Division of
UNITED-CARR FASTENER CORP.
51 Glen Road
Mountainside, N. J.

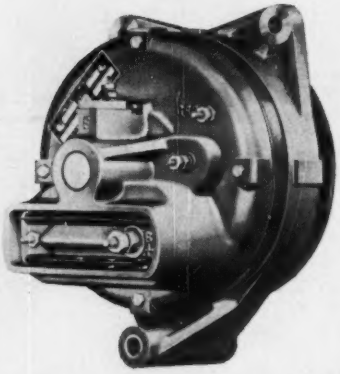
PALNUT
TRADE MARK
LOCK NUTS
for quick, secure fastening at low cost



DC Power Supply . . .

. . . for dielectric testing of cables and klystron apparatus and for the study of high-voltage discharges. Sorensen Model 2350-8, oil-insulated, with output range up to 350 kv, uses selenium rectifiers to reduce overall size and weight of unit. It will provide continuous current of 8 ma at any output voltage setting and offers 2% rms ripple. Auxiliary filters are available to reduce ripple down to 0.01%.

Sorensen & Co, Inc, Richards Ave, South Norwalk, Conn.



Automotive Generator . . .

. . . assures easy engine starting even in the most severe weather and permits full use of all electrical accessories at all speeds (including idle). The 6,000 Series alternator is 40-amp and designed for medium-duty service on any automotive vehicle. It delivers 5 to 10 amp at curb idle, yet it is priced no higher than comparable dc generators. It is well suited for construction, maintenance, or repair cars or trucks 6 or 12-v electrical systems.

Leece-Neville Co, 1374 E 51 St, Cleveland 3, Ohio.

MINERALLAC
"PULL-IN"
COMPOUND
No. 100

LISTED and APPROVED by UNDERWRITERS LABORATORIES

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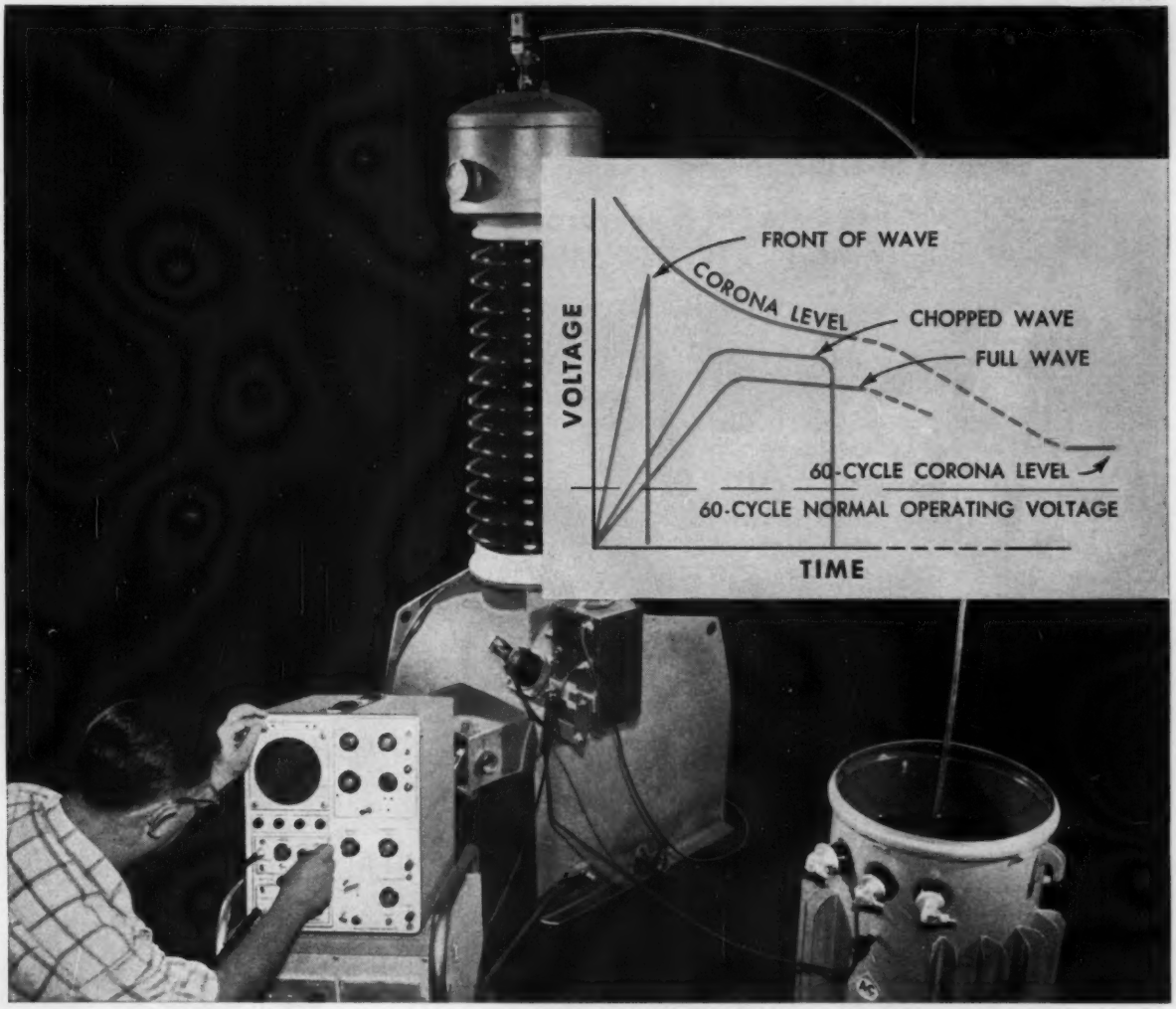
ALLIS-CHALMERS

A-1391



Proven corona-free design lengthens transformer life

Allis-Chalmers transformer insulation (both winding and barrier) is designed (and proven by tests) to be *entirely free of corona* . . . not only at the operating voltage, but at *all test levels*. By use of superior measuring techniques and instrumentation, Allis-Chalmers engineers have established design criteria which bring this benefit to all A-C transformers from 5 kva through power transformers of all sizes and range. Corona — the cancer of electrical equipment — is eliminated. The problems of carbonization of insulations and thermal breakdown of oil are substantially reduced.

Extensive studies on "compatibility" of insulations have also helped to increase transformer life. Through accelerated tests on many laboratory models and long-time tests on completed transformers Allis-Chalmers engineers have determined the ideal material combinations. Controlled processing to eliminate air and moisture lowers moisture content to as low as twenty parts per million.

Because of these three major factors . . . all A-C transformers in the above ratings built since January 1, 1960, are capable of delivering a twelve-percent increase in capacity at 65 C rise without loss of life.

• • •

For more information *about the additional built-in capacity of Allis-Chalmers transformers call your nearby A-C representative. Or write, Power Equipment Division,* **Allis-Chalmers,** *Milwaukee 1, Wisconsin.*

A-1391

FOR VOLTAGES OF 600 OR LESS

There's a *Safe and Dependable* BUSS Fuse or FUSETRON Fuse to fit the needs of every user...

...AND FUSES PROVIDE THE HIGHEST DEGREE OF PROTECTION AVAILABLE

Unlike mechanically operated devices, fuses have no hinges, pivots or contacts to stick or get out of order. They require no periodic inspections, recalibration and corresponding down-time. A fuse is just as safe and accurate 20 years or longer after installation as it is on the day installed.

Buss
LOW-PEAK Fuses
200,000 amp. interrupting capacity . . . great current limitation . . . plus long time-lag.
Ask for Bulletin LPCS

FUSETRON
dual-element Fuses
All purpose protective device for circuit, motor or equipment protection.
Ask for Bulletin FIS

Buss
Hi-Cap Fuses
For loads above 600 and up to 6,000 amps. 200,000 amp. interrupting capacity, —plus current limitation.
Ask for Bulletin HCS

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LIMITRON Fuses
High interrupting capacity fuses with exceptional current limitation.
Ask for Bulletin HLS

BUSS makes a complete line of fuses for home, farm, commercial, electronic, electrical, automotive and industrial use.

Buss Super-Lag
Renewable Fuses
Lowest cost protection where periodic short-circuits are frequent.
Ask for Bulletin RCS
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One-Time Fuses
Low cost, safe protection for heating or lighting circuits where faults do not exceed 10,000 amp.
Ask for Bulletin NCS
Buss
Clear Window
Plug Fuses
One piece body and "safety" design guarantee protection.
Ask for Bulletin WUS
Buss
FUSTAT Fuses
Fusetron fuses with Type "S" base resist overfuseing or tampering.
Ask for Bulletin SCPS
Fustata for motor protection.
Ask for Bulletin SMPS
FUSETRON
dual-element
Plug Fuses
Safely stop needless blows. Give full protection against short-circuits and overloads.
Ask for Bulletin TCPS
BUSS
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Small Dimension Fuses
and Fuseholders
For the protection of all types of electric and electronic devices.
Ask for Bulletin SFB
Get the Facts... write
Bussmann Mfg. Division, McGraw-Edison Co.
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PROTECT YOUR EXPENSIVE OVERHEAD EQUIPMENT WITH

WEAVER GROUNDS

Leading Electric Utilities Specify WEAVER Equipment for Long-lasting, Trouble-free Grounding

GROUND RODS

Heavy, uniform copper coating, molecularly bonded to a rigid steel core, assures permanent grounding. The copper is work-hardened and resists scarring in rocky soil. A special draw gives the core more rigidity and with machined point driving is easier . . . chamfered top eliminates mushrooming and splitting.

GROUND ROD CLAMPS

Cast of high-strength, silicon aluminum bronze, yet cost no more than extruded types of clamps. Design guarantees perfect alignment between ground wire and rod. Big half-inch screw with rounded point gives high pressure contact without damaging the copper on the rod . . . machine-cut threads withstand high torque without stripping or breaking. Available with socket or square heads.

POLE BOTTOM GROUND PLATES

Weaver Plates with 25% more copper area than other types of plates, provide better overload dispersal . . . yet cost no more. It is the only plate with a heavy duty cast bronze connector to give high pressure contact between plate and ground wire . . . assures long-lasting, safe grounding.

J. A. WEAVER Company

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Electrical World

FEBRUARY 6, 1961

Management Newsletter

Psychological Tests – Tool or Trap?

Which do you prefer? Would you rather write a great play, or attack points of view that differ from your own? Either way you're all right. There's no correct answer. But by the time you have answered 200 of these simple choice problems, you have told your employer things about yourself that 50 years ago he might never have learned.

The questions are part of a personality inventory—one of the many psychological tests which are becoming as much a part of American life as the mustard-drenched hotdog. And the rapid pace with which they are gaining favor in industry has stunned and frightened commentators on our civilization.

"Testing is immoral" cries one school of thought. "It delves into areas which are as sacred to an individual as the sacrificial altars were to the ancient religions." Another group that commands an audience calls testing ineffective. "If psychological tests had been used 30 years ago, some of our best corporate leaders would never have been promoted from office boy." And still another school of criticism aims its guns at what testing is doing to individuality. "Psychological tests are producing a generation of stereotypes. To differ from your fellow man is becoming a crime. The tests are traps for the individualist."

If psychological tests are a germ in our society, then the germ is rapidly becoming a plague. Aptitude tests and personality inventories are spreading. In 1954 the National Industrial Conference Board did a survey to find out just how many companies were using the various forms of psychological tests. 43% of the companies questioned had testing as a part of their hiring and advancement process. But only 27% of these were large companies. In 1960, however, when the Harvard Business Review made a study, 50% of the companies were test fans. And the bigger industries had jumped on the bandwagon. They now represented 65% of the testing companies.

Utilities are keeping well abreast of the trend. Of the 50 largest utilities, close to 70% are using some kind of psychological test. Naturally, with more of the large concerns involved, a vastly greater number of executives are standing before the test's X-ray gaze as part of the employment and advancement processes, prompting the Business Review to say, "It is clear that almost without exception, the next generation of top executives will have had considerable experience with psychological tests."

But not everyone thinks testing is a disease. Some test salesman try hard to leave the impression that it's a panacea for all of industry's personnel woes. Not only do they show the ability of some tests to predict employee capabilities, but they infer that tests are wonder-tools, effective no matter who holds them. Just feed the papers into a machine and go out for coffee. The test does the rest.

Crouched in a foxhole between these two warring fronts are the professional-psychologists. These are the makers of the tests, and they are less than happy about both the panicky charges, and the extraordinary claims. To these professionals, tests are an instrument just like the stethoscope. They're no better, nor worse than the doctor who places them against your chest. They make a man's aptitudes, and personality traits more obvious just as the stethoscope amplifies the sound of a heart. But they don't make decisions. That's up to the doctor.

Some of the charges against testing are unjustified, says an officer of the Psychological Corp, a leading producer of mental tests. He states quite frankly that tests might contribute to a trend toward conformity, but insists that this isn't the fault of the tests. A personality inventory for example, merely shows those personality traits which a person possesses to a greater or less extent than the average for all people. Conformity comes in when a company uses this measurement to eliminate people who vary from the norm. This is a company decision roughly equivalent to an employer who decides that candidates for promotion must be members of his old undergraduate fraternity. The responsibility belongs with the executive who makes the decision, not with the test.

Do tests infringe on individual privacy? "Yes," says this same psychologist. "But so does a credit check." He reasons that no one would sell a car on time without making a thorough search of the customer's credit rating. Why not learn something of a man's aptitudes and personality traits before entrusting him with an important job?

But tests aren't panaceas, and the Psychological Corp takes a dim view of promoters who overstate their value. "Tests are still in their infancy," says a company spokesman. "Some are fairly well developed. Others are downright crude. It depends on which test you are talking about."

Aptitude tests are widely helpful, and are by far the most frequently used. More than 85% of the industrial orders placed with the Psychological Corp fall into this category. 36% of these orders call for general intelligence tests, and better than 50% ask for tests to measure a specific aptitude such as clerical or mechanical ability.

But personality inventories, which have limited legitimate application, are requested far less frequently, totaling to less than 10% of the requests. Some psychologists feel that this breakdown in orders shows that industry realizes the relative validity of the different categories of tests. If businessmen wanted more personality inventories than aptitude measurements despite the fact that aptitude measurements are generally more reliable, something would be wrong.

What are these tests? What do they measure? And just how useful can they be to a utility? We can find answers to these questions by examining the two general categories: aptitude tests, and personality inventories.

An aptitude is a set of characteristics which point to an individual's ability to acquire, *with training*, some skill. The stronger the aptitude, the better a person's chance of success in a given line of work. Aptitudes have been around just about as long as man has. But measuring them is relatively recent. At the turn of the century, aptitude testing was almost non-existent. In fact, the term "mental test" was first used in 1890 by James Cattell. He reasoned that a close indication of a person's mental ability could be gathered by testing his sensory discrimination; the keeness of his eyesight and his reaction time, for example. His views reigned until 1905, when Binet, developed a test which measured a man's judgement, comprehension, and reasoning. Binet's tests were the first to furnish a "mental age" which leads to the more familiar "IQ." During the First World War, Army psychologists developed the tests for group application, and following the war, colleges and schools began using them to bring students of equal ability together. Suddenly, the nation became IQ conscious.

In the Second World War, military psychologists decided that IQ tests didn't measure the entire span of human intelligence. They measured only verbal ability, and ability to handle abstract relationships. Psychologists then studied the various tests and broke the questions down according to the aptitudes they tended to isolate. All questions aimed at a specific aptitude were pulled together developing a test which probed for a single ability rather than for some measure of general intelligence. After extensive experiment, differential batteries weighing mechanical ability, clerical speed and accuracy, language ability, numerical ability and many other aptitudes, began to appear.

Do aptitude tests really work? Apparently they do. Testmakers, and industrial personnel officers have often been able to demonstrate their validity in measuring a well-defined aptitude. In the ideal case, they give a test to a group of new employees performing a particular kind of work, and then put the tests into a safe for a period of several months. Only after the men have been evaluated by their supervisors are the tests brought out again for comparison. And, in many instances the test scores match up with the evaluations of the supervisors.

An electric utility discovered that scores on a clerical aptitude were quite indicative of success as a line crew foreman. It uses the test to screen applicants for line construction work. Some utilities have found engineering aptitude tests indicative of whether a young engineer is best suited for sales, development engineering, or pure research. A manufacturing company found a close correlation between mechanical aptitude tests and employee turnover. Of those scoring high on the test, only 14% quit within one month. But 39% of the low scorers quit in the same period. Apparently the more aptitude men had for the work, the better they liked it. And the better they liked it, the longer they stayed.

Once a company has found that a particular test does predict to some degree the future success of an applicant for a job, or of a candidate for promotion, it would be foolish for the company to forego this information in making its selection. But the Psychological Corp warns strongly against making the test the sole basis for selection. Many things enter into an individual's success besides his aptitude for the work. The test will not measure his motivation, the harmony of his home life, his honesty, and the countless other elements that make one man a better worker than the other. It should be used hand in hand with a thorough process of interview and background study. A utility can use most aptitude tests successfully without the assistance of a trained psychologist. Naturally, the more care that is used, the better the results will be. But as long as it uses the tests to supplement its present interviewing program, and avoids the temptation to make them the sole judge of whom to hire or promote, it can probably do a better job than it could do without tests.

Personality inventories, which are much more controversial than aptitude tests, are also of relatively recent origin. The earliest versions were the oral "free

association" tests in which the examiner would say a word, and ask the subject to answer with the first word that came to his mind. This procedure was used chiefly with abnormal patients. During World War I the personality questionnaire, or self-report inventory was developed. This form listed many statements about personal habits and characteristic to which a person was asked to write yes or no as an indication of whether the statement applied to him or not. Forms of the "yes-no" device were the principle attempts to measure personality traits until the Second World War when forced choice techniques were developed. In this method, the person is presented with alternative situations, both of which are equally acceptable to people in general. He decides which of the choices is most preferable to him and the accumulation of several hundred such choices is used as an indication of personality. If these tests work, they are a fine supplement to the aptitude test. For they measure those areas which the aptitude instruments cannot reach, such as:

- Deference: Ability to take suggestions and follow instructions.
- Dominance: Desire to lead, to force your own viewpoint.
- Change: Ability to do new and different things, to adjust to new situations.
- Aggression: Desire to attack other points of view, to criticize.

But unfortunately, personality inventories are still in their infancy. There is very little proof of their validity for prediction of industial performance.

Personality instruments run into several problems which don't apply to aptitude tests. First, the behavior which they measure is subject to greater change than is true of an aptitude. This means that a person may show up differently on the same personality inventory taken at two different times. Secondly, it is difficult to compare a man's personality with the test results. Personality is very complex, and it is almost impossible to accurately evaluate dominant personality traits by observing everyday actions. Another problem is that personality inventories can be loaded. The person being tested can, to some extent, make himself look like the kind of person he wants to be.

What good are personality inventories if we are uncertain of their validity? For general application in utilities, they are not very good at all. But in specific circumstances and in the hands of a skilled psychologist, they can be a valuable tool. One company, after administering the inventory, found that most of its successful salesmen showed a particular pattern of personality traits. They hired a psychologist to study the results of the test and determine whether this correlation between the personality trait and success in selling the company's product was more than coincidental. Over a period of several years the psychologist determined the inventory scores which gave the best indication of future success. He finally concluded that for this company, the personality inventory used was an indicator of future selling ability, and was relevant to sales success. Several utilities have taken this same thorough approach to personality measurements. Some have found an inventory of real value, and use it extensively. Others have been unable to prove the test valid and have dropped it completely. Some utilities have developed their own personality inventories to measure a particular trait which is valuable to their operation. One electric company uses an extensive test which it developed to check a person's ability to function under emergency conditions and is quite happy with the results. But the only way a company can know if an inventory is useful is to run a clinic-type study of its own with the help of a competent psychologist, to test the validity for its particular situation. Personality inventories, as of yet, have no "across the board" value.

Even where validity is indicated, testmakers offer the familiar caution. Don't make the inventory your sole judge. It's only an indicator. Psychological tests, whether aptitude tests or personality inventories, are far from perfect. Yet they can be a tremendous asset to a company in its personnel selection and training program. When properly used, they probably do not deserve the critical attack which has been leveled against them. But still, they are only a tool, no wiser than the people who administer them.

NEW

Bethalume ACSR Core Wire

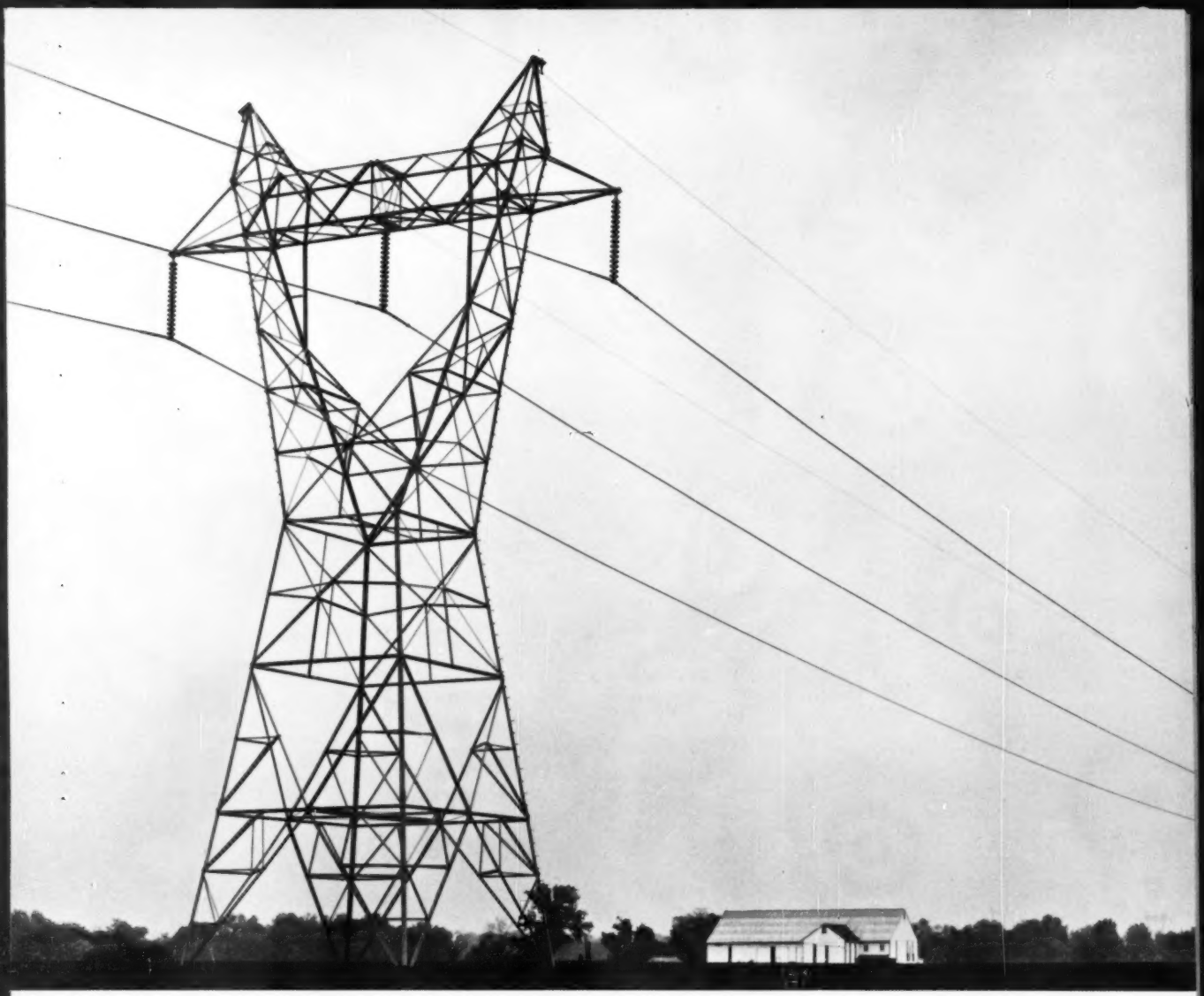
HIGH CORROSION RESISTANCE • MINIMUM MAINTENANCE

LONG LIFE • EASY STRANDING

Choose from three types of Bethlehem ACSR core wire:
Bethalume, Bethanized, Hot-Dip Galvanized

BETHLEHEM STEEL

BETHLEHEM STEEL



With the addition of the new Bethalume (aluminum-coated) wire to our list of dependable ACSR core wires, Bethlehem now offers the widest possible choice of wire for reinforcement of standard electrical conductors. Bethlehem's new Bethalume ACSR core wire joins with our exclusive Bethanized (electrolytic zinc-coated) and hot-dip galvanized ACSR core wire to give you a selection that meets virtually every atmospheric condition, with years of additional service life built in.

NEW BETHALUME COATING GIVES YOU *FIVE* IMPORTANT ADVANTAGES:

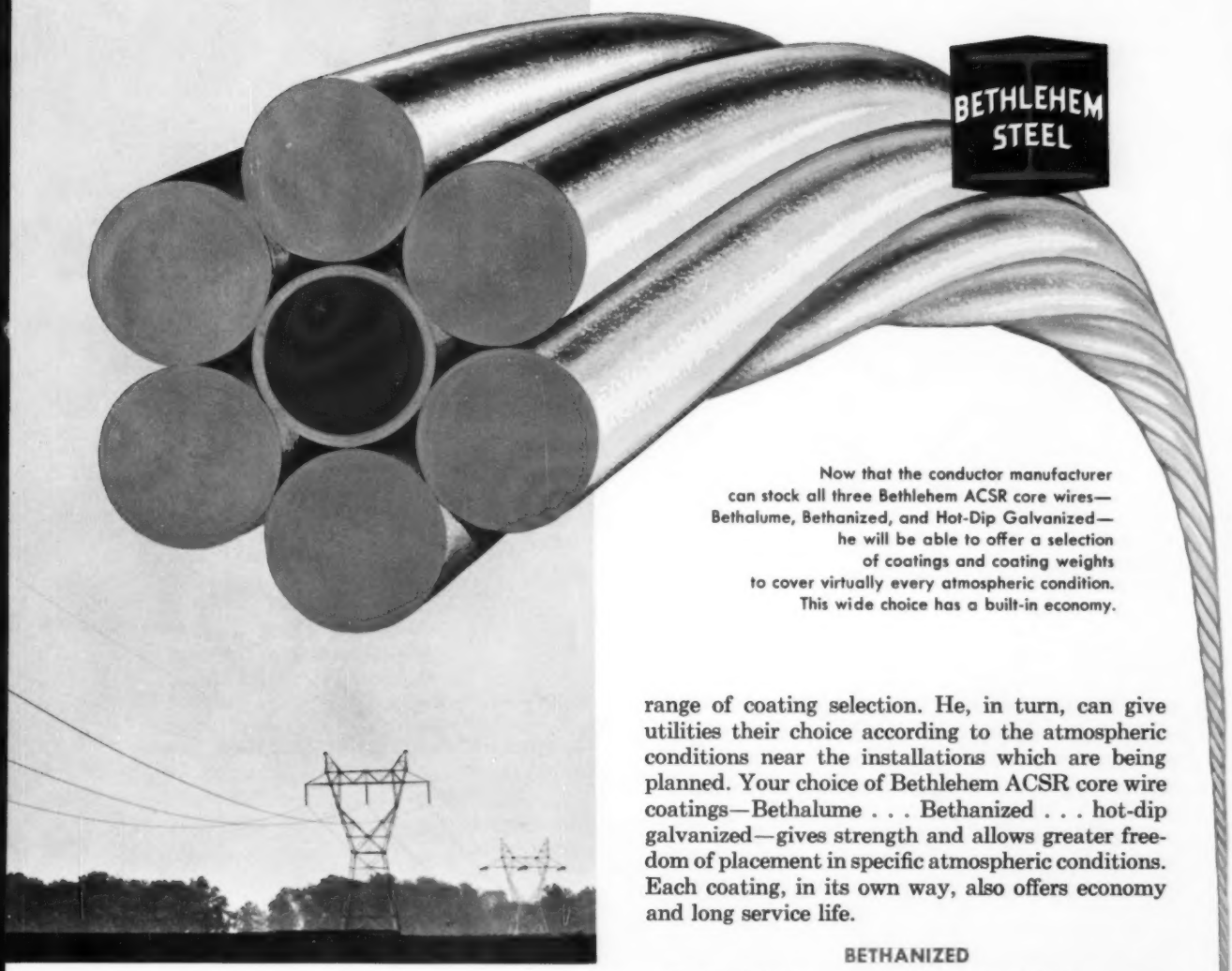
1. *Long Life* made possible by the combination of the high tensile strength of steel and the excellent corrosion-resistant properties of aluminum.

2. *High Corrosion-Resistance* due to the highly protective aluminum oxide which forms as soon as the wire emerges from its molten bath. This film, though transparent, gives the steel wire long-lasting protection against corrosion, even in severe industrial atmospheres.

3. *Dependable Performance* because Bethalume ACSR core wire is manufactured in accordance with ASTM Specification B-341.

4. *Minimum Maintenance* because the steel wire is strong enough to withstand heavy winds and rough winter weather, yet has the high corrosion-resistance afforded by the Bethalume coating.

5. *Easy, Trouble-Free Stranding* into standard aluminum conductors. Bethlehem's painstaking inspection, sizing, and cleaning during production permit almost perfect bond between steel wire and aluminum coating. No injurious flaking or peeling will occur during stranding.



Now that the conductor manufacturer can stock all three Bethlehem ACSR core wires—Bethalume, Bethanized, and Hot-Dip Galvanized—he will be able to offer a selection of coatings and coating weights to cover virtually every atmospheric condition. This wide choice has a built-in economy.

BETHLEHEM ACSR CORE WIRE IS TOUGH AND STRONG

Manufactured to ASTM specifications, Bethlehem core wire is made from a high carbon grade of basic open-hearth steel to obtain the high tensile strength and high degree of toughness required for its demanding application. Close attention to wire mill procedures, testing, and inspection make Bethlehem ACSR core wire the ideal mechanical reinforcement for high-tension electrical conductors.

NOW YOU CAN CHOOSE FROM THREE BETHLEHEM CORE WIRES

Bethlehem's full line of high-strength ACSR core wires offers the conductor manufacturer the widest range of coating selection. He, in turn, can give utilities their choice according to the atmospheric conditions near the installations which are being planned. Your choice of Bethlehem ACSR core wire coatings—Bethalume . . . Bethanized . . . hot-dip galvanized—gives strength and allows greater freedom of placement in specific atmospheric conditions. Each coating, in its own way, also offers economy and long service life.

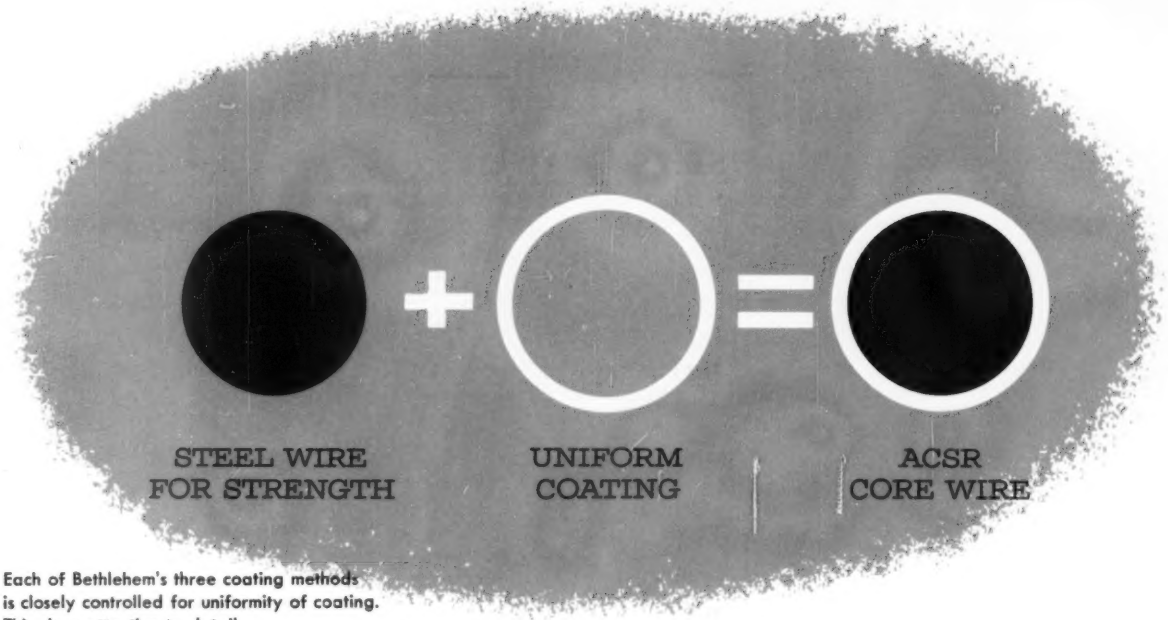
BETHANIZED

Bethanizing is our unique electrolytic process which produces a zinc-coated wire with a uniform and tightly bonded coating of virtually pure zinc. It makes possible coatings two times, and three times the standard weight—adding years of service life to ACSR conductors. The Bethanized coating weights available are: standard (A), heavy (B), and extra-heavy (C). Bethanized ACSR core wire is manufactured in accordance with ASTM Specifications B-245 and B-261.

HOT-DIP GALVANIZED

Bethlehem's method of zinc-coating ACSR core wire by passing it through a molten zinc bath results in a highly dependable, and economical product, with a heavy, galvanized coating of zinc which is twice the standard weight. It is manufactured in accordance with ASTM Specification B-245.

BETHLEHEM STEEL



Each of Bethlehem's three coating methods is closely controlled for uniformity of coating. This close attention to detail assures you of top-quality ACSR core wire.

PACKING

Bethlehem ACSR core wire is furnished in coils of one continuous piece, and in coil weights as recommended in ASTM Specifications B-245, B-261, and B-341.

SIZES AND TYPES MADE AT BETHLEHEM PLANTS

Type	Sparrows Point, Maryland	Johnstown, Pa.	Los Angeles, Calif.
Bethalume	—	.1878 to .0661 in., inclusive	—
Bethanized, "A" "B" & "C" Coatings	.1878 to .0661 in., inclusive	.1878 to .0525 in., inclusive	—
Hot-Dip, Double Galvanized	.1878 to .0589 in., inclusive	.1878 to .0661 in., inclusive	.1878 to .0661 in., inclusive

Our salesmen will be happy to discuss the advantages of each of our ACSR core wires. Call or write the nearest Bethlehem sales office, or write to us at Bethlehem, Pa. We'll supply complete information.

Steel

for Strength
... Economy
... Versatility

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Field Lighting Tests Assure Best Results

ERNEST H. HILL, Engineer, Electrical Projects, Arizona Public Service Co, Phoenix, Ariz.

Since June, 1957, Arizona Public Service Co has been conducting field performance tests on all brands of 400-w, mercury-vapor street light luminaires presented for purchase approval.

As a result, it is felt that street lighting customers of the company are receiving the maximum amount and best uniform distribution of street lighting available.

We were prompted to establish field performance tests due to visually recognized differences in light output from various brands of 400-w, mercury-vapor luminaires. However, it was felt that visual differences were not ample to justly rule a luminaire "acceptable" or "unacceptable." Moreover, it was desirable to show a vendor why his luminaire was or was not being purchased, and what criteria it would have to meet to be acceptable.

Representatives of the City of Phoenix, Salt River Power District, and Arizona Public Service Co met, and, using as a guide the American Standard Practice for Street and Highway Lighting approved Feb. 27, 1953, they inventoried what was to be desired in good roadway lighting using 400-w, mercury-vapor luminaires.

It was the opinion of the representatives that the American Standard Practice did not prescribe all the criteria considered necessary to insure good uniform lighting for heavy traffic arterial roads. Therefore, after due consideration, the Field Performance Requirements shown in Fig 1 were established, and a suitable test location, as shown in Fig 2, was developed.

On the test area, a survey crew laid out the grid system and drove shiners into the pavement to give permanent reference locations for light intensity measurements.

Due to the initial high lumen output of mercury-vapor lamps, they

(*Continued on page* 92)

Fig. 1—Field Performance Requirements

Mercury vapor, horizontal-burning luminaires

Test Plot— 1100 West Jefferson St.

Luminaires— Five luminaires of type being tested shall be used.

Lamps— Five lamps of type being tested shall be used. These shall be seasoned and tests shall be made after 200 burning hours and before 800 burning hours.

Minimum Performance:

1) The average footcandles on pavement shall be not less than 1.15 ft-c

2) No single point on any line shall be less than:

Line A	—	.35 ft-c
Line B	—	.60 ft-c
Line C	—	.95 ft-c
Line D	—	.95 ft-c
Line E	—	.95 ft-c
Line F	—	.60 ft-c
Line G	—	.35 ft-c

3) The following ratios shall be maintained:

	Average to Low	High to Low	High to Average
Total Street	Not more than 4:1	Not more than 9:1	Not more than 4:1
Each Line	Not more than 2:1	Not more than 45:1	Not more than 2.5:1

Instructions:

a) Footcandle readings shall be taken at each station. Methods used shall conform to IES Guide for Outdoor Illumination Tests.
b) An Isolux Chart shall be prepared for 1 span only. Four readings shall be averaged to obtain each single reading in this span.
c) All performance values are to be taken from values in this averaged span.

Luminaires shall be acceptable mechanically and electrically, and shall be so constructed as to require a minimum of maintenance.

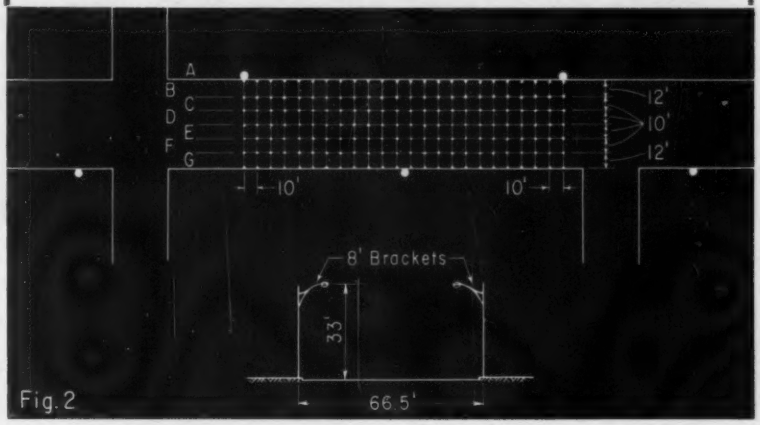
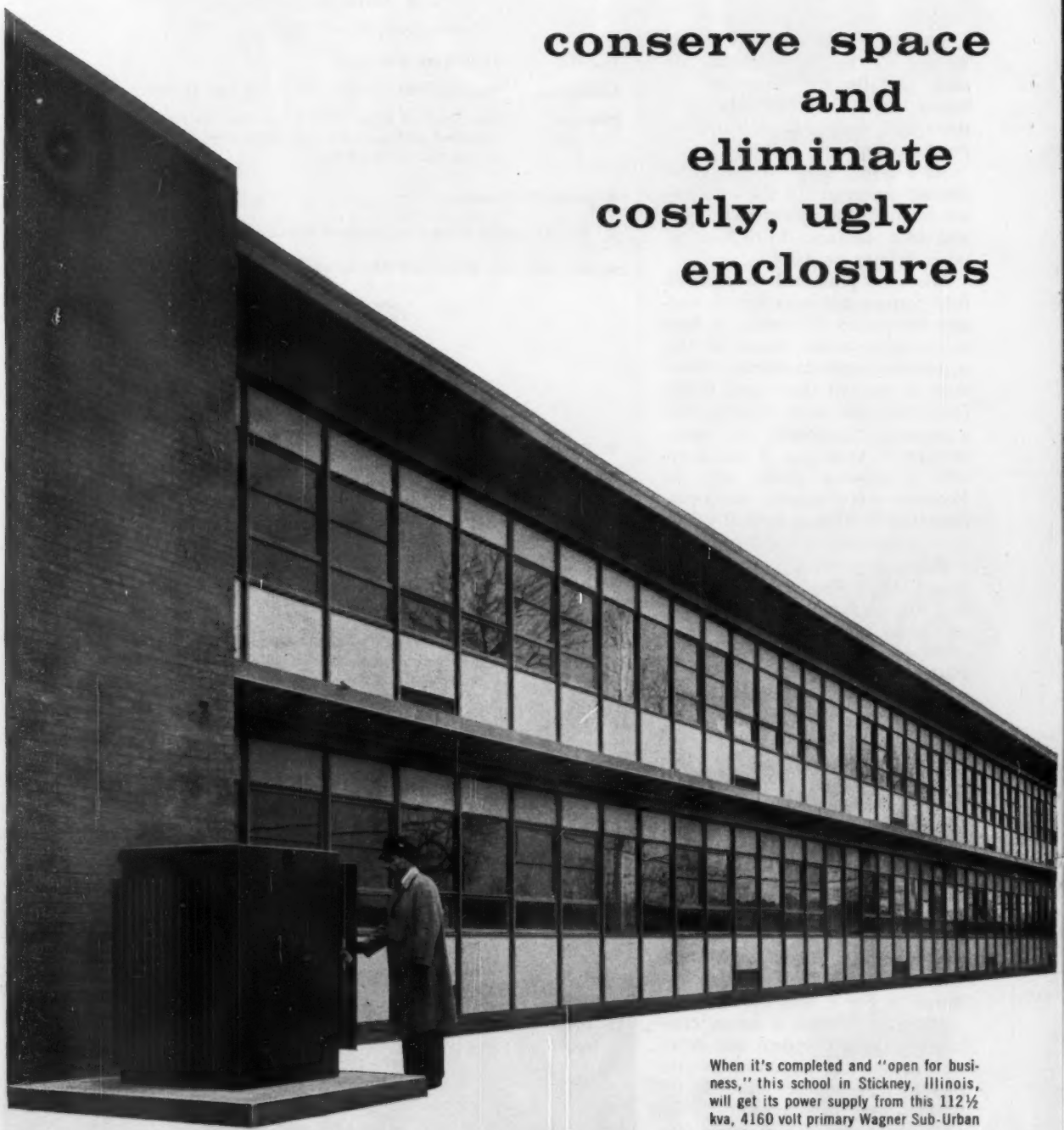


Fig. 2

In Industrial and Commercial Installations . . .

WAGNER® SUB URBAN PAD

conserve space and eliminate costly, ugly enclosures



When it's completed and "open for business," this school in Stickney, Illinois, will get its power supply from this 112½ kva, 4160 volt primary Wagner Sub-Urban transformer.

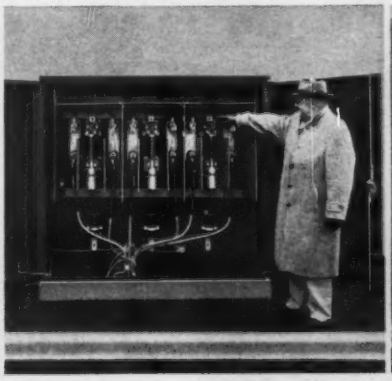
MOUNTED TRANSFORMERS

Thinking of going undergound? If you're planning a new distribution substation... reworking or modernizing an existing system... write Wagner® Sub-Urban pad mounted transformers into your specifications. It's the economical way... the complete unit is mounted above ground, and no costly vaults or enclosures are necessary. Save space, too. They're so well ventilated they can be installed close to the building and still be loaded to capacity. Some low shrubbery will hide them neatly... the good looks of your buildings and landscaping are retained.

Incoming lines and outgoing feeders are completely out of sight, buried in the ground. And far fewer faults occur in an underground system over a period of time than would generally occur in a comparable overhead system. People who use the buildings served by pad mounted transformers are protected from exposed hot lines, and your crews are protected by a door over the primary compartment which lets them work on the secondary without danger from high voltage. Enclosures lock tightly to protect the equipment itself.

Wagner Sub-Urban pad mounted transformers are available in singlephase, 25-167 kva; threephase 75-750 kva. They require only routine maintenance, and when load growth makes it necessary, larger transformers can be quickly and easily installed to replace original units.

This Wagner Sub-Urban transformer is installed at the Park Ridge, Illinois, executive offices of the Square D Company. It is a 500 kva, three-phase delta-connected, 4160 volt primary transformer.



H. D. Ely, senior staff engineer of a large midwestern utility points to the special HV switching arrangement which permits sectionalizing the primary of a three-phase loop system at the Square D Company.

These transformers serve the Dorchester Club in Dolton, Illinois. The larger transformer supplies power to refrigerate an indoor skating rink. The smaller unit powers the club's general services and all-electric kitchen.

Check with your Wagner Sales Engineer. He's got complete data on Sub-Urban pad mounted transformers... all the facts and figures that prove how easy it is to plan less costly, space-saving transformer installations.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

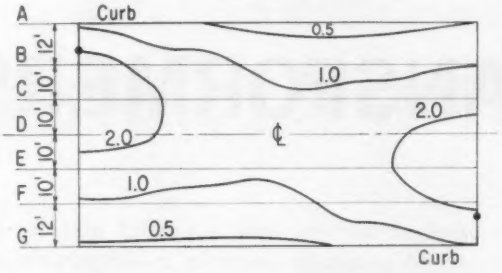
Wagner Electric Corporation

6456 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

WT61-1

Fig 3—Isolux Diagram and Performance Values

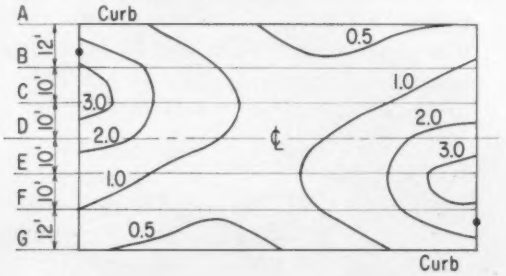
(For an acceptable luminaire using a clear MV lamp)



	Total Area	Individual Lines A	B	C	D	E	F	G
Ave ft-c on Pavement	1.19	.51	1.19	1.64	1.80	1.59	1.13	.50
High ft-c	2.80	.75	2.38	2.76	2.52	2.80	2.31	.73
Low ft-c	.41	.41	.79	1.07	1.19	1.06	.78	.41
RATIOS								
Ave to Low	2.90	1.24	1.51	1.53	1.51	1.50	1.45	1.22
High to Ave	2.35	1.47	2.00	1.68	1.40	1.76	2.04	1.46
High to Low	6.83	1.83	3.01	2.58	2.12	2.64	2.96	1.78

Fig 4—Isolux Diagram and Performance Values

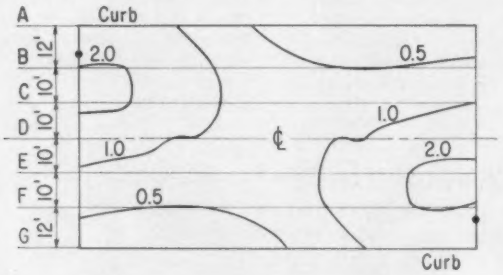
(For an unacceptable luminaire using a clear MV lamp)



	Total Area	Individual Lines A	B	C	D	E	F	G
Ave ft-c on Pavement	1.17	.71	1.24	1.50	1.48	1.42	1.15	.66
High ft-c	3.33	1.65	3.03	3.33	2.29	3.27	2.80	1.50
Low ft-c	.36	.36	.57*	.74*	.82*	.74*	.57*	.36
RATIOS								
Ave to Low	3.25	1.97	2.18*	2.03*	1.80	1.92	2.02*	1.83
High to Ave	2.85	2.32	2.44	2.22	1.58	2.30	2.44	2.27
High to Low	9.25*	4.58*	5.32*	4.50	2.79	4.42	4.91*	4.17

Fig 5—Isolux Diagram and Performance Values

(For an acceptable luminaire using a coated MV lamp)



	Total Area	Individual Lines A	B	C	D	E	F	G
Ave ft-c on Pavement	.94*	.63	1.02	1.15	1.14	1.09	.95	.60
High ft-c	2.25	1.34	2.08	2.19	1.57	2.25	2.09	1.35
Low ft-c	.23*	.23*	.49*	.66*	.74*	.67*	.49*	.23*
RATIOS								
Ave to Low	4.09*	2.74*	2.08*	1.74	1.54	1.63	1.94	2.61*
High to Ave	2.39	2.13	2.04	1.90	1.38	2.06	2.20	2.25
High to Low	9.78*	5.83*	4.24	3.32	2.12	3.36	4.27	5.87*

* Substandard

are seasoned so as to be operating in a more uniform period of light output at the time of luminaire testing. The minimum amount of seasoning is 200 hr and the maximum at time of testing is 800 hr as shown in the Field Performance Requirements.

To approximate laboratory conditions when testing, extra installation care is taken in leveling and aligning test luminaires at 33 ft above the pavement. When possible a manufacturer's representative is asked to accompany the Arizona Public Service Co crew making the installation.

Preliminaries to the taking of light intensity measurements consist of notifying the City Traffic Division (Routing) that one or two traffic lanes will be blocked off during testing, waiting for ample darkness and giving the test unit lamps adequate time to obtain full brilliance, activating the cosine-corrected light meter by exposure to light for 15 min, and taking proper safety precautions to guide traffic away from testing personnel.

Light intensity measurements are taken and recorded for each of the points indicated in Fig 2.

Effects of moonlight or passing automobile headlights have been found to be negligible.

In order to equalize to the extent possible the effects of smudges on the refractors, incorrect alignment of luminaires, or other extraneous factors, the two spans of Fig 2 are averaged down to one span.

These averaged values are used for constructing an isolux or iso-foot-candle diagram. These values are also used to provide the criteria specified in the FPR.

It is interesting to note the differences in the isolux diagrams and performance ratios for "acceptable" and "unacceptable" luminaires which are shown in Fig 3 and Fig 4.

The effect of using coated mercury-vapor lamps instead of clear in 400-w luminaires is readily noticeable when a comparison is made between the isolux curves shown in Fig 3 and Fig 5. This effect is made more conspicuous when observing a rating of 25,000 lumens for the coated lamp and only 21,000 lumens for the clear lamp. This shows how an acceptable luminaire will test unacceptable because a coated lamp was used.

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RESOURCES *in* RESEARCH

Georgia is opening the eyes of the world to new wonders in Science. As a result of Georgia's record appropriations for education, young eyes will look deeper into the world of the future . . . and skilled scientists will discover broad, new horizons for the betterment of man and industry.

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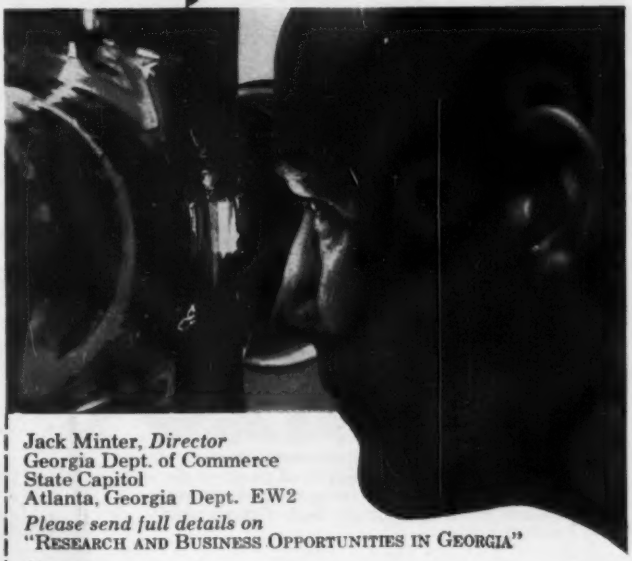
For 150 years, the University of Georgia has followed a tradition of scientific achievement. Today, with its $12,500,000.00 Science Center, a new era of education and research opens vast opportunities for better living in an ever-changing world.

The University of Georgia's Science Center is dedicated to the proposition that scientific achievement is without real meaning unless it is supported by the arts, the humanities and the professions.

The Science Center is just one phase of Georgia's forward-planning to provide scientifically equipped manpower for industrial research and product development.

S. Ernest Vandiver

S. ERNEST VANDIVER, *Governor*



Jack Minter, *Director*
Georgia Dept. of Commerce
State Capitol
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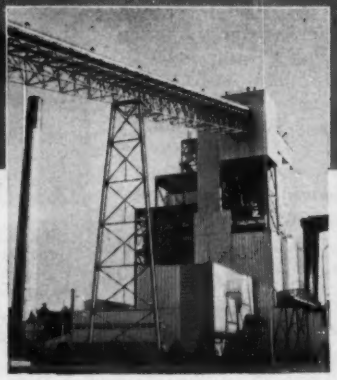
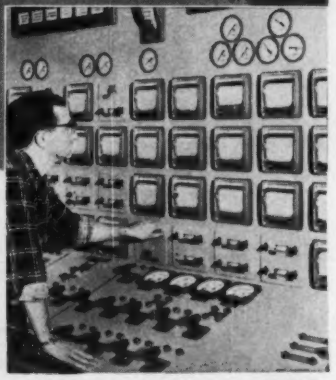
GEORGIA DEPARTMENT OF COMMERCE

this is the **complete** Foxboro Control Panel for

FOXBORO BOILER TURBINE CONTROL panel at Merrimack Station, Bow, N. H. includes complete combustion, feed water, and steam temperature control systems. All pneumatic instruments are located on vertical portion of panel — electrical switches and dials are on integral operating console, resulting in simpler back-of-panel piping and wiring.

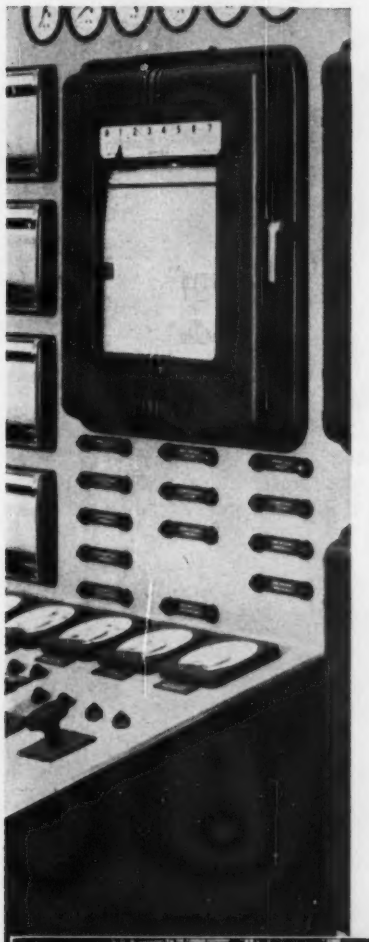


PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE'S new cyclone-fired boiler plant at Bow, N. H., generates 815,000 lb./hr. of 1875 psi steam at 1005 F superheat.



FOXBORO CONSOTROL RECORDERS have full-scale 4-inch charts — the same scale as large case instruments. Note — operator's console is an integral part of Foxboro control panel.

Boiler Turbine
a 100,000 kw Steam Station



compact Consotrol* instruments help Public Service of New Hampshire slash control costs of new Merrimack Station

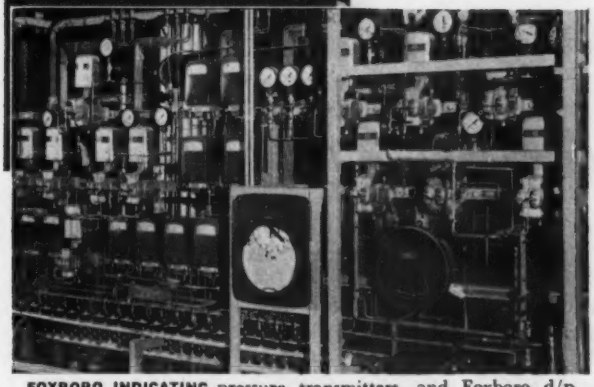
A compact control center which completely eliminated the need for a separate operator's console resulted in many significant savings for the Public Service Company of New Hampshire.

By using small-case Foxboro Consotrol control stations, the recording panel and the operator's console were combined in one integral unit. Results: plant operation is more efficient, because recorded variables and control switches are all *directly* in front of the operator. Total installed cost was reduced because the need and the expense of transmitting variables and control signals between the panel and the console were eliminated.

In addition, valuable control room space was saved, states David Merrill, Station Superintendent.

If you're interested in better control—at lower cost—investigate the Consotrol story. Your nearby Foxboro Field Engineer will gladly give complete details. Write for Bulletin 13-18. The Foxboro Company, 242 Norfolk Street, Foxboro, Mass.

Reg. U. S. Pat. Off.



FOXBORO INDICATING pressure transmitters, and Foxboro d/p Cell* flow transmitters, located on rack next to boiler, transmit boiler measurements to central control panel. Station design allows for 3 additional boiler units.

Reg. U. S. Pat. Off.

FOXBORO
REG. U. S. PAT. OFF.

Crist Is Named Executive VP At Southern Co

CRIST

VOGTLE

James F. Crist has been named executive vice president of The Southern Co. T. Hunt Vaden succeeded Crist in charge of the Birmingham office, and Alvin W. Vogtle Jr replaced Crist as president of Southern Electric Generating Co, subsidiary of The Southern Co.

Crist entered the electric power business in 1926 when he joined Alabama Power Co. Two years later he went to South Carolina Power Co, and became a vice president in 1941. He was vice president of Gulf Power Co from 1948 to 1956. A Southern Co vice president since 1947, Crist has been president of the generating company since 1957.

Vaden has been a vice president of Southern Co since 1952. Vogtle is a Birmingham attorney.

Niagara Mohawk Power Elects Slater VP

Harry G. Slater has been elected a vice president of Niagara Mohawk Power Corp. He will have executive supervision of a new department concerned with the over-all promotion and sale of electricity and gas, and customer, investor, and all other public relations. He will also continue to serve as associate general counsel.

A Harvard College and Law School graduate, Slater was special assistant to the US Attorney General, a member of the Securities & Exchange Commission, and chief counsel for the SEC's Division of Public Utilities before joining Niagara Mohawk in 1951 as assistant general counsel.

HARRY G. SLATER ▶

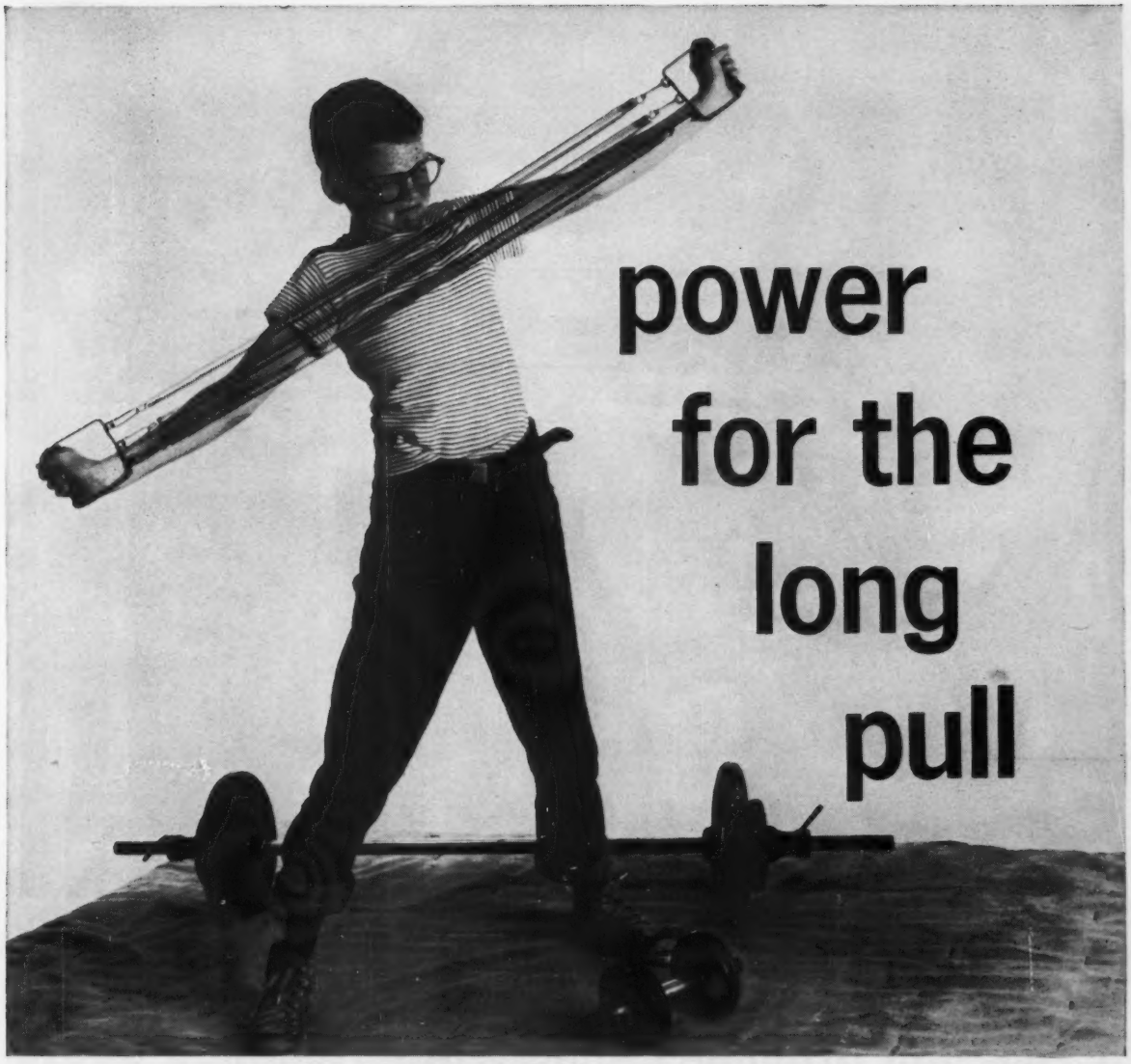
Wilcox Is Westinghouse Vice President

Westinghouse Electric Corp has appointed George L. Wilcox vice president and assistant to the president. He has been president of Canadian Westinghouse Electric Co, Ltd, since 1955.

Wilcox will undertake special assignments for the president in matters of domestic and foreign competition and customers relations, including the cooperative studies with electric utilities (EW, Dec. 19, 1960, p 49).

Joining Westinghouse in 1942 as a design engineer, Wilcox held numerous executive posts, including executive vice president of Westinghouse Electric International Co, before becoming head of Canadian Westinghouse.

(*More News About People on page* 100)



PEABODY's Two Billion Tons Of Coal Reserves Assure You Of An Abundant Fuel Supply... Far Into The Future!

Peabody Coal Company's *two billion tons of proven reserves* are your assurance of a dependable source of fuel for the long pull. These reserves... along with Peabody's continuous development of productive mining properties—economically accessible to the nation's inland waterways and rail facilities... are your guarantee of an abundance of power for years to come.

Whether you use a carload or a trainload, your business is important to Peabody. From consultation on power problems to the end result Peabody offers a complete coal service. Contact your nearest Peabody office for complete details.

Learn more facts about Peabody Coal... its importance to the nation's economy and your business. Send for Peabody's new FREE booklet, "COAL... ANCIENT STOREHOUSE OF MODERN LIVING." Write Department EW.

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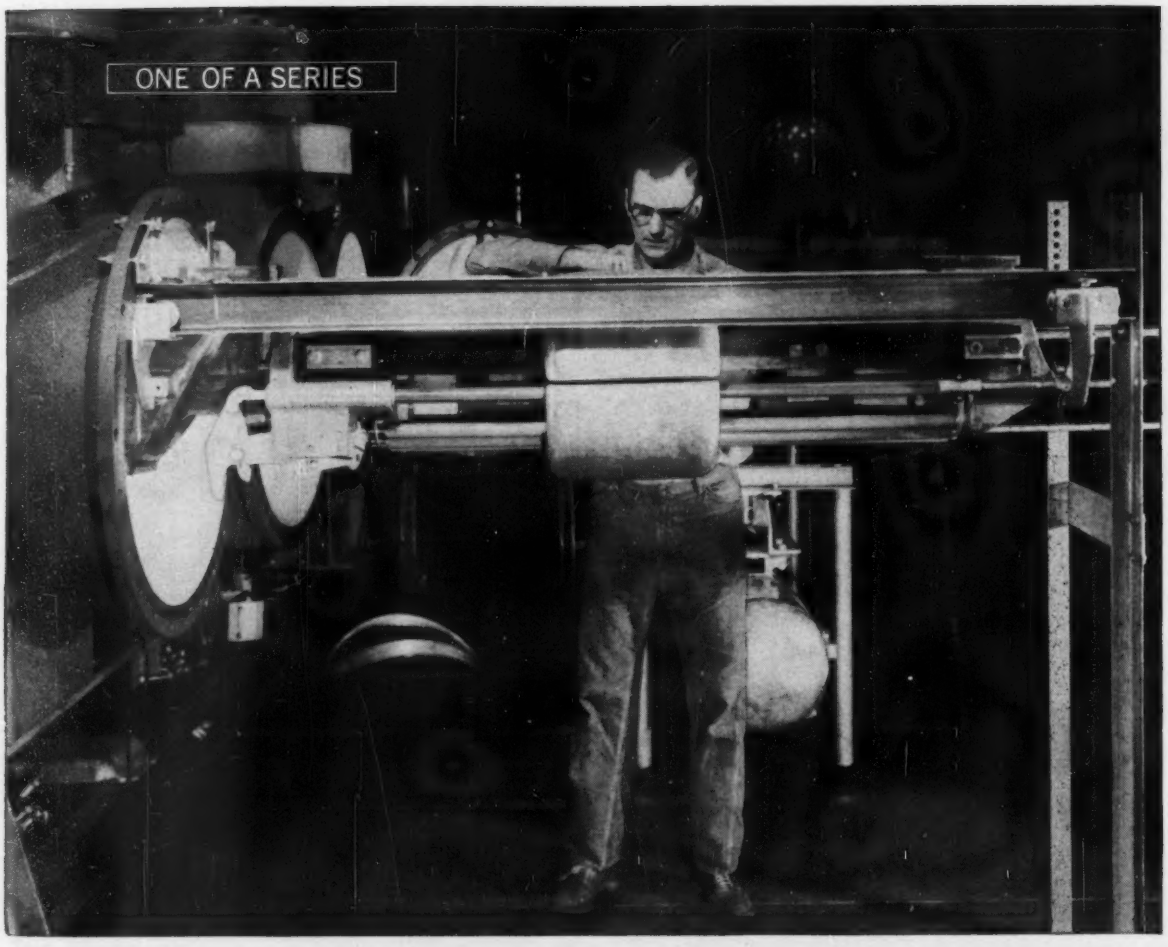
Offices in: Chicago, Columbus, Des Moines, Detroit, Indianapolis, Kansas City, Louisville, Madison, Wis., Memphis, Minneapolis



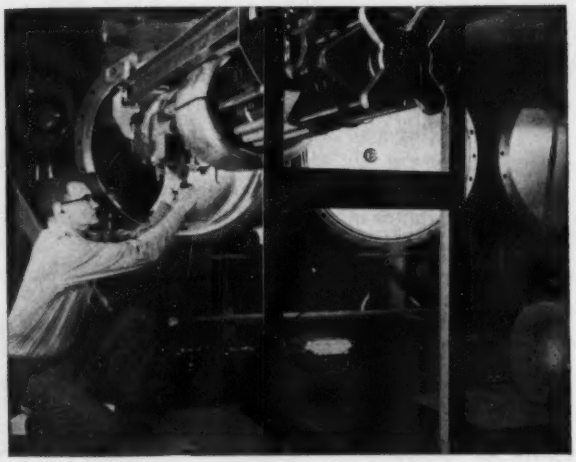
New, Easy, Ground-level Inspection of SF_6 Gas Breaker Slashes Maintenance Costs

provides greatly improved performance from 69 to 460 kv and beyond

A unique horizontal interrupter design in the new Westinghouse gas power circuit breaker now brings the interrupters within easy reach of the maintenance man. No scaffolds, block and tackle or ladders are required to inspect breaker contacts. Now workmen can perform all maintenance comfortably . . . from the ground!

The interrupter can be removed from each tank of the Westinghouse breaker in just 15 minutes.

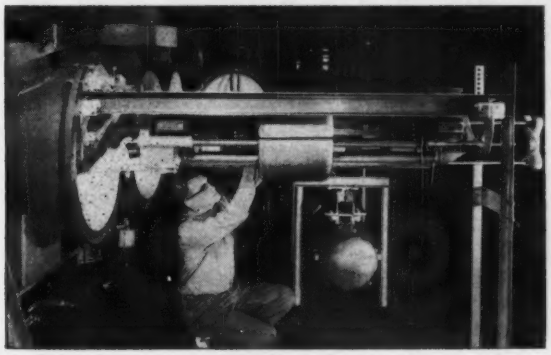
After evacuation of the SF_6, a set of lightweight aluminum rails is installed inside the pole unit. Trolleys are attached to the interrupter; bolts are removed at the bushings, operating rod and high-pressure tube. The interrupter can then be pulled out for inspection. There is no heavy equipment to be lifted! There is no easier way to remove an interrupter.



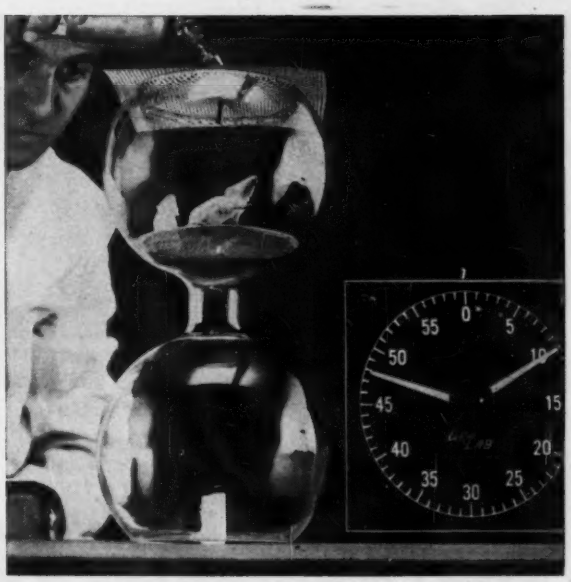
Operation of the interrupter is easily checked by attaching a jack and opening and closing the contacts by hand. This convenient operation-check is another cost-saving advantage over other breaker designs.

The advanced interrupting techniques developed in this new gas breaker, improved contact design and efficiency of the SF_6 (sulfur-hexafluoride) interrupting medium combine to *reduce the need* for periodic maintenance to a fraction of present accepted practice. *Over-all* maintenance costs of the Westinghouse gas breaker are estimated to be less than half those of other breakers.

Extensive field and laboratory experience (since 1953) has proved that SF_6 is completely safe to use



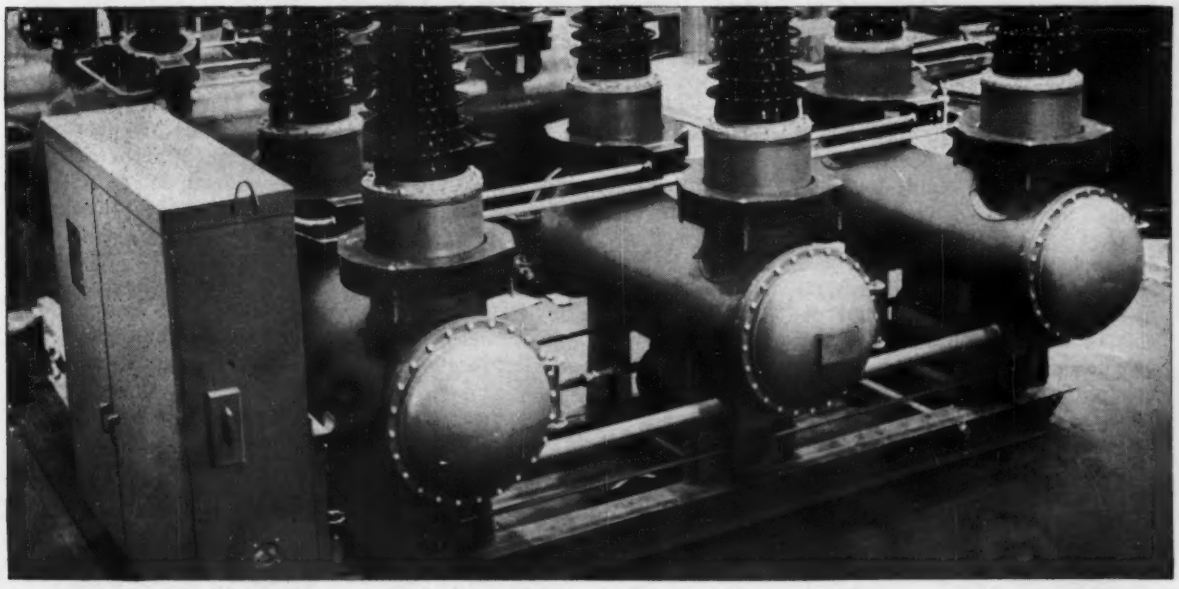
without any harmful effect on personnel. Only precautionary measures of the common-sense variety are recommended. The gas is carefully filtered by activated alumina, as it is circulated in the breaker high- and low-pressure systems, to remove any gaseous arc products. Any solid arc products left in the pole unit after evacuation can be quickly blown out



with compressed air.

This inert, nonflammable, nontoxic gas is heavier than air as demonstrated in the laboratory experiment above. The SF_6 sinks to the bottom, snuffing out the candle. Tests show that the mice can live in a mixture of 80% SF_6 and 20% oxygen for 24 hours without ill effect.

To learn more about the way the Westinghouse gas breaker can cut installation and maintenance costs and increase breaker performance, call your Westinghouse sales engineer. Or, write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. You can be sure . . . if it's Westinghouse. J-61006



Westinghouse Gas Breakers for Improved Performance from 69 to 460 Kv and Beyond

Westinghouse

Mead Becomes Consumers Public Power District President

MEAD

WAGENER

Earl I. Mead has been elected president of Consumers Public Power District (Nebr.) for 1961, succeeding Wayne E. Barber, a businessman who ended two consecutive one-year terms.

Guy L. Cooper Jr was re-elected first vice president, and Frederick H. Wagener became second vice president. P. W. Lakers was elected to a two-year term as treasurer, while Mark T. Moore was re-elected secretary.

Mead, a businessman, was advanced from second vice president. He has served as CPPD's president in 1949, 1955, and 1956. Wagener, an attorney, was elected to the board in November, 1960.

PERSONAL BRIEFS

Dr William E. Parkins has become associate technical director of Atomics International division of North American Aviation, Inc.

Daystrom, Inc, Weston Instruments Division has a new general sales manager: **Harold L. Russell.** Also, **William J. Slawson** joined Weston's sales staff as product sales manager of Vamistors. In the control systems division, **Thomas Waldrop** became sales manager-systems; **John Warner,** sales manager-control systems department; and **Durward Graham** manager of technical publications.

Hevi-Duty Electric Co, division of Basic Products Corp, has named **Raymond G. Nordstrom** executive vice president responsible for marketing functions.

Leonard K. Schwartz has been elected a vice president and assistant to the president-International Projects of Henry J. Kaiser Co, and vice president of several subsidiaries engaged in international activities.

Allan C. Wight has become sales manager for generators, defense sales, and railroad equipment, and **Carl L. Holverstott,** sales manager of industrial motors, both in the industrial motor and generator sales department of General Motors' Delco Products division.

Graybar Electric Co has elected Secretary and Comptroller **R. D. Paine** a director.

General Electric Co has named **Philip H. Light** manager-electric utility analytical engineering for the electric utility engineering operation.

New public relations assistant at Puget Sound Power & Light Co is **Richard E. York.**

Edmund M. Diaz III has joined Duke Power Co's personnel department as training supervisor. **J. Wesley Lewis** was named manager of Duke's Durham district, succeeding **Earl C. Dameron** who retired. **J. A. Jones Jr** has been named manager of Duke Power Co's transportation department. **C. E. Poovey** was made executive assistant; **E. R. Davis** became manager of the industrial power department; and **Patrick D. Huff,** manager of the distribution engineering and operation department.

William R. Kollmayr, western division sales manager for New Jersey Power & Light Co, has been elected chairman of the Farm Electrification Council of New Jersey.

Central Maine Power Co has made **Ibra L. Ripley Jr** assistant district manager at Rumford, replacing **David Y. Holden** who resigned to accept a post with Raytheon Co. **Charles F. Grove** became local manager at Gardiner, and **Kenneth A. Peterson** was named Raymond local representative.

Carolina Power & Light Co has promoted **Olin H. Broadway** to assistant manager of district operations. **R. Tyler Presson Jr** became senior rate engineer in the rate department. **James S. Currie,** who retired as North Carolina Commissioner of Revenue, joined CP&L as assistant to the treasurer.

George V. Patterson has been promoted to the newly created post of assistant to the executive vice president for operation of American Electric Power Service Corp, New York. **Lt-Gen James J. Gavin,** president of Arthur D. Little, Inc, was elected to AEP's board of directors.

Arkansas Power & Light Co has appointed **H. F. Minnis** assistant to the president. **W. Mills Murphey** was named manager of a new corporate services department, and **C. A. Clift** assumed responsibility for divisional operations.

The following changes have occurred at Washington Power Co's Noxon Rapids Cabinet Gorge operation: **John Graham** became superintendent of Cabinet plant, succeeding **Roy E. Ferguson** who retired, and **Herb Roehling** succeeded Graham as superintendent of the Noxon plant.

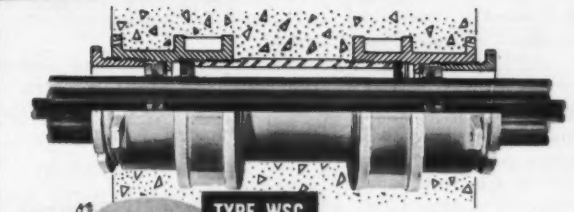
John Rocca O'Hanlon has been elected assistant secretary of Potomac Electric Power Co.

Niagara Mohawk Power Corp's new assistant controller is **Malcolm B. Romeiser.**

(*More News About People, p* 102)

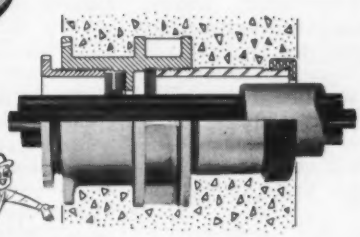
NEW! a complete line of O.Z. WATERTIGHT ENTRANCE FITTINGS for Conduit or Cable

End leakage problems once and for all! O.Z.'s new wall and floor entrance fittings for installation in concrete provide a positively watertight seal around conduit or cable at any pass-through point! Use them with threaded or unthreaded steel conduit, fibre or Transite® conduit, or exposed cables of varying number and sizes. Gland-type sealing assemblies, with pressure bushings, may be tightened at any time. Fittings accommodate conduit ranging from ¾" to 6". Standard types, sizes available from stock. Specials made to order.



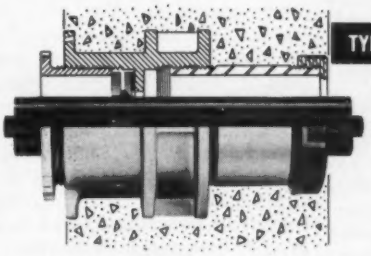
TYPE WSC

HERE'S A SEAL FOR DIRECT BURIAL CABLE.



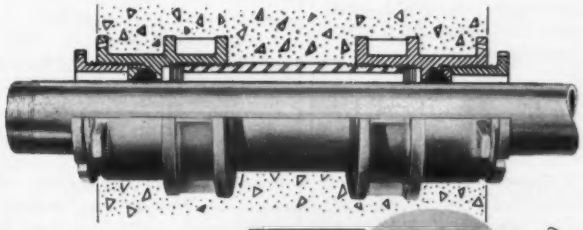
TYPE FST

HERE'S ONE FOR CABLE IN TRANSITE, FIBRE OR UNTHREADED STEEL CONDUIT.



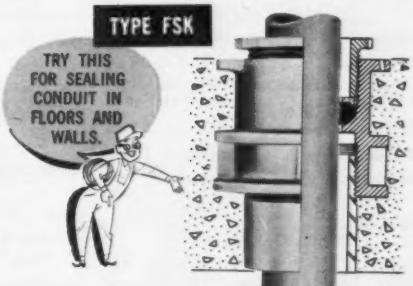
TYPE FSC

THIS ONE CAN BE USED IN FLOORS AND THINNER WALLS.



TYPE WSK

THIS ONE'S FOR CONDUIT WALL ENTRANCE SEALING.



TYPE FSK

TRY THIS FOR SEALING CONDUIT IN FLOORS AND WALLS.

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For more information on fittings and other O.Z. products, call your local distributor, or write to the company.

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O.Z. ELECTRICAL MANUFACTURING CO., INC.

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SALES ASSIGNMENTS

COMPANY STAFFS

Allis-Chalmers Manufacturing Co has named George G. Butenkoff and Thomas A. Johnson as sales representatives to the Hartford and Columbus districts, respectively.

Continental-Diamond Fibre Corp has transferred Charles A. Trusk to its New York district. Trusk will be responsible for the sales in the Hartford, Conn., territory.

I-T-E Circuit Breaker Co has transferred Dale G. Hebron to the Los Angeles district office at 1921 E 7th St. I-T-E has also established two new district sales offices to serve its West Coast clients. George W. Geiger will head the new Portland office, at 1010 SW 14th St, servicing Oregon and three southern Washington counties, and William V. Knowles will head the Seattle office, at 910 5th Ave, covering the remainder of Washington and the northern corridor region of Idaho.

Day-Brite Lighting, Inc, has appointed James C. Ramsey Western regional sales manager with offices at 530 Martin Ave, Santa Clara, Calif.

Gould-National Batteries, Inc, has made George P. Millington Jr central zone manager. With headquarters at the Trenton, N. J., executive offices of the industrial division, Millington will cover 16 Midwestern states.

H. K. Porter Co, Inc, has promoted Edward S. J. McVickar to manager of mining and welding cable sales, national electric division. J. D. Williams was made manager of the division's Houston branch.

Fisher-Pierce Co has appointed John J. Mahoney Jr as sales engineer.

REPRESENTATIVES

Day-Brite Lighting, Inc, has a new representative in the San Jose, Calif., area: Leon P. O'Neill. He joined the staff of Brundage Lighting Associates, Day-Brite's San Francisco representatives, located at 821 Howard St.

Allis-Chalmers Manufacturing Co has appointed J. H. Larson Electrical Co a distributor for A-C motors, controls, and transformers, and an agency for regulators, power transformers, switchgear, and circuit breakers. The distributor, located at 530 N Third St, will serve areas of Minnesota, Wisconsin, and South Dakota.

Books

Practical Rate Guide Reissued . .

Electric Utility Rate Economics, 2nd printing, by Russell E. Caywood. Sponsored by *Electrical World.* Published by McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y. 236 pages, illustrated. Price $10.00.

This is a practical guide to rate making by a man long in this field and for many years manager of rates for West Penn Power Co. Its breadth is indicated by mention of some of its coverage: metering, statistical methods, engineering economics, sales, financing, pertinent utility history. Caywood explains over seventeen rate classes and special rate practices and describes the technical factors influencing price structure. Examples of problems and their solutions and a generous number of tables and charts provide pragmatic aids.

The book was first published in 1956.

Maintenance Gets Assist

Master Receiving-Tube Substitution Guide Book, by H. A. Middleton. Published by John F. Rider Inc, 116 W 14th St, New York 11, N.Y. 350 pages, illustrated; paper bound. Price $7.45.

Primary purpose of this data book is to help radio and TV servicemen to find acceptable substitutes for unavailable receiving and TV picture tubes, including a number of European manufacture. But to the extent that such tubes are used in utility electronic gear of many types, it could also aid technicians and engineers who service this equipment.

Explains Computers Simply

Basics of Analog Computers, by Tho D. Truitt and A. E. Rogers. Published by John F. Rider Publisher, Inc, 116 W 14th St, New York, N. Y. 400 pages, illustrated. Price $12.50.

The concepts, devices, and applications of analog computers are presented in comprehensive form with more than 400 explanatory illustrations. Simply explained are the basic types of analog devices, the mathematical concepts involved, the detailed working of modern general purpose analog computers, and practical applications of computers. The dc electronic differential analyzer, dc analog computer, and ac analog computer as well as computer components are described in a form easy to grasp by one with the slightest understanding of engineering. Monitoring and control, programming techniques and problems, automatic programming, and computer applications are described.

Maintenance technicians and programmers of analog computers will find this book a good introduction to analog computers.

Books Recently Received

Infrared Radiation, by Henry L. Hackforth, Published by McGraw-Hill Book Co, 330 W 42nd St, New York 36, N.Y. 288 pages, illustrated. Price $10.00.

Mechanical Design of Hydro Plants. Published by Tennessee Valley Authority, Treasurer's Office, Knoxville, Tenn. 986 pages, illustrated. Price $3.75.

High Voltage Direct Current Power Transmission, by Colin Adamson and N. G. Hingorani. Published by Garraway Ltd, 11 Kensington Church St, London W. 8, England. 286 pages, illustrated. Price $14.00.

1301 Review Problems from EIT and Professional Registration Examinations, by Brinker, Bourquin, Hassler, Whitacre and Young. Published by International Textbook Co, Scranton 15, Pa. 387 pages, illustrated. Price $7.50.

Progress in Dielectrics, Volume 2, edited by J. B. Birks and J. H. Schulman. Published by John Wiley and Sons, Inc, 440 Park Ave South, New York 16, N.Y. 230 pages illustrated. Price $9.50.

Basics of Induction Heating (2 volumes), By Chester A. Tudbery. Published by Rider Publications. 116 W 14th St, New York, N. Y. 284 pages, illustrated. Price $7.80.

Distribution Systems, by electric utility engineers of Westinghouse Electric Corp, East Pittsburgh, Pa. Published by Westinghouse, 570 pages, illustrated. Price $8.00.

Elektrizitaetswerke und Hochspannungsleitungen in Ostdeutschland und Polen, vor u. nach 1945. Published in German by the East Europe Institute of the Free University of Berlin. Ehrenbergstrasse 35 Berlin-Dahlem, Germany. 230 pages, with tables and maps; paperbound. Price DM 16.

Formel- und Tabellenbuch fuer Starkstrom-Ingenieure. Published in German by Siemens-Schuckertwerke AG, Erlangen, West Germany. 704 pages, illustrated. Price DM 29.80.

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BLACK & VEATCH
Consulting Engineers
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MULTI-AMP ELECTRONIC CORPORATION
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Portable electric test equipment
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For low voltage testing and calibrating of circuit breakers, protective and overload relays, reclosers, watt hour meters, fuse links.
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EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.		DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

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Send to office nearest you.
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CHICAGO 11: 520 N. Michigan Ave.
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Electrical Engineer familiar with electric power systems. Permanent employment with opportunity for advancement in long-established consulting engineering firm. Write or call Stanley Engineering Company, Muscatine, Iowa.

Construction Supervision. Construction Engineer for inspection and supervisory work on electric power lines and substations. Opportunity for permanent employment and advancement with well-known consulting engineering firm. Send resume to P-6001, Electrical World.

POSITION WANTED

Electrical Construction Engineer, 15 years experience as superintendent for construction of oil refineries, steam power plants, gas turbine power plants, industrial plants etc. Desire similar job, domestic or overseas. PW-5975, Electrical World.

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Productive advertising is an INVESTMENT rather than an EXPENDITURE.

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BE CONVINCED — send us your advertisement TODAY.

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ELECTRICAL WORLD
330 W. 42nd St., N. Y. 36, N. Y.

WHO'S WHO in—
Electrical Equipment Representatives
Write for free copy of EERA Directory
C. W. SWARD, Executive Director EERA
1675 Fifth St. Clermont, Florida

ELECTRIC UTILITY SALES

New England firm has immediate opening for a man with a good understanding of electric utility transmission and distribution practices to sell to the electric utilities, directly and through manufacturers' representatives.

Requirements: At least two years' experience in direct sales to the electric utilities through a high-grade sales organization. (Please do not apply at this time if experience has been with contractors, distributors, or jobbers only.) Graduate E.E. preferred but not essential—experience is the most important consideration.

We are a medium-sized corporation with excellent acceptance throughout the electric utility industry. Our diversified products and plans for future expansion offer a challenging opportunity to the man meeting these requirements.

Send resume to

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Class. Adv. Div. P.O. Box 12, N.Y. 36, N.Y

LARGE POWER EQUIPMENT
Prompt Stock Shipment
RENUBILT MOTORS - GENERATORS
TRANSFORMERS - CIRCUIT BREAKERS
DO YOU GET OUR STOCK LIST?
BELYEA COMPANY, INC.
51 Howell St. Jersey City, N. J.
OL-3-3334

TURBO-GENERATOR

New—Unused—In Original Cases G. E. 33,000 kw Turbine Generator Preferred Standard—H2 Cooled, 13,800 V., 60 cycles.

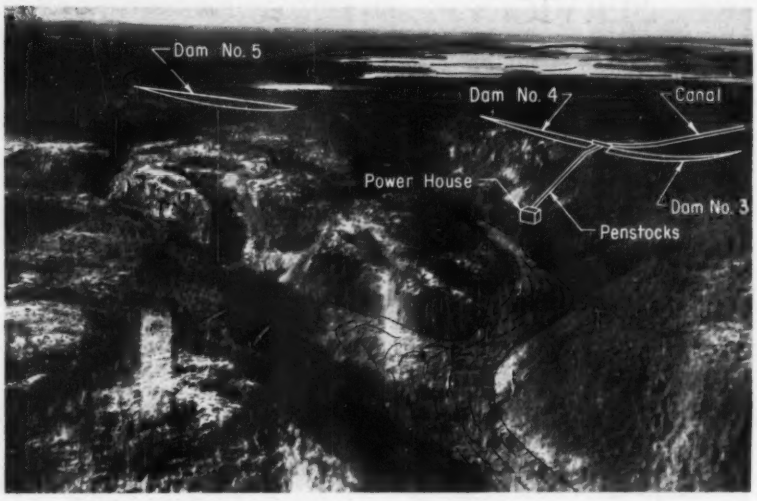
ATTRACTIVELY PRICED

For Further Information—Contact

Ebasco International Corporation
100 Church St., New York 7, N. Y.
ATT. J. Forsyth

New Hydro Project in Labrador Bush Under Way

A 160,000-hp hydro development to provide power for an iron mining operation 110 miles away is under construction in bleak Labrador. The project, which may ultimately reach 300,000 hp, is being constructed by British Newfoundland Corp, through a subsidiary, Hamilton Falls Power Corp, Ltd. The site is near Hamilton Falls, where a hydro potential of some four million hp is being studied. The on-power date for the initial 120,000 hp, being supplied to the Iron Ore Company of Canada and Wabush Iron Company's new iron mining operations and townsite, is June, 1962.



This power plant is to be built at Twin Falls on the Unknown River, a tributary of the Hamilton River, at a site about 250 miles north of Seven Islands and 12 miles southwest of Hamilton Falls.

The topography at Twin Falls is unusually advantageous for hydroelectric development. In a three-mile stretch of the river, including two sets of twin falls, the total drop is more than 400 feet. Running roughly parallel with the river is a dry gorge, whose upper end is about 300 feet below the normal water level above the falls. The river will be diverted from the plateau level through a canal and penstocks to a power house in this gorge.

The 8,400 sq mi catchment area will provide an estimated minimum flow of 3,450 cfs without regulation. At the net head of 290 ft., this can produce 125,000 hp firm at 80% load factor. For the initial installation, therefore, the plant will be run-of-the-river.

As the demand increases, up to 12 feet of storage can be provided in the two large lakes feeding the Unknown River flows. The regulated flow in a dry year will then be 8,100 cfs, sufficient for 300,000 hp firm at 80% load factor.

A rock-filled, timber crib, overflow dam about one mile above the upper set of falls will divert the water into a canal approximately 6,000 ft long. The canal excavated mainly in earth, is designed to take flow required for a 180,000 hp installation with a maximum water velocity of 2 feet per second. It can later be enlarged to 300,000 hp. as more power is needed.

The concrete intake structure, built into a 470,000 cu yd earth dam, will have provision for three 60,000 hp units. Intakes for two more units can be added later.

The power house will contain two units initially but rock excavation will be carried out for the ultimate five units. The plant will operate on local automatic control.

Transmission will be at 230 kv. The line will go by the most direct route to the Wabush Lake area, a distance of about 110 miles.

Availability of power and other facilities at Twin Falls will assist subsequent development of the main 4,000,000 hp potential at Hamilton Falls.

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Strandvise® alone

has these straight-down-the-line abilities

FEED-THRU *ability*

Nothing approaches the value and ease of the feed-thru mechanical chuck for placing and tensioning a guy. Use no tensioning tools until after the guy is in place. Then each click of the hoist feeds strand thru the chuck to desired tension.

ONE-MAN *ability*

A one man "crew" can complete a down guy easier, faster and safer than with any other method. Strandvise is a "natural" even for EHS strand.

USE *ability*

No precision pre-cutting. No markers to locate and line up. No size color codes to remember.

NO-CORRODE *ability*

External—Tube and yoke are each a homogeneous aluminum alloy. There is no coating . . . scratching or abrasion cannot initiate corrosion.

Internal—Both laboratory tests and field service exposure (natural cycling) have repeatedly failed to show evidence of corrosive attack on strand within the gripping area. Tapers and initial tension wedge and seal that area.

RE-USE *ability*

Strandvise is wholly reusable; once, twice, or a dozen times.

ADJUST *ability*

Luck plays no part during the tensioning operation. Strandvise "swallows" strand with each click of the hoist—Tension is a fact.

NO-ABRASION *ability*

The stainless steel bail has no peers. There is no coating to abrade away. 18-8 stainless steel will never rust or deteriorate in any known corrosive atmosphere.

REACH *ability*

The overall length of Strandvise averages less than 12 inches for most sizes.

SAFE *ability*

No need to remove come-along or hoist to gain working space before the job is completed. With Strandvise the load is always captive.

NATURAL *ability*

Nothing to study—nothing to avoid—nothing to ("look-out!") for—wholly safe to install without safety glasses and gloves (where regulations permit).

NO-FOUL-UP *ability*

The only wire is the guy wire. The only ingenuity called for is already built into Strandvise.

PROCEDURE *ability*

Give or take guess work is no part of Strandvise—nothing to get ready, nothing to allow for. (Stainless bail cannot stretch.)

MULTIPLE GUY *ability*

Double and triple guying to one guy rod presents no working space problems with Strandvise.

TAMPER-PROOF *ability*

Mischievous release is impossible unless the "villain" has a hoist and come-along.

COST *ability*

You can use every Strandvise you buy . . . none are rendered useless by storage or handling damage, or by field mistakes.

Installed costs favor Strandvise all the way. One man for five minutes is all the "help" Strandvise needs for a *completed* down guy.

HOLDING *ability*

Forged and case hardened chucks are quality controlled at factory and are consistent by nature of design and tooling. No grit or combination of coatings to be controlled and trusted.

During 27 years of continuing production, it has never been reported that a Reliable Feed-Thru Deadend Chuck let go a line. (Strandvise is in its twelfth year of production.)

Reliable

A Symbol of Integrity Since 1909

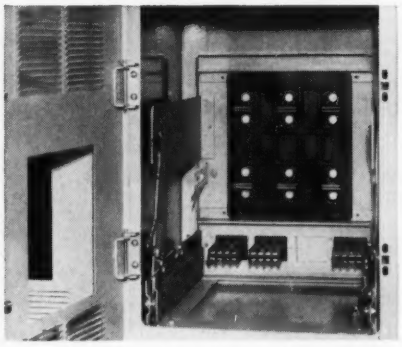
RELIABLE ELECTRIC COMPANY

Franklin Park, Illinois

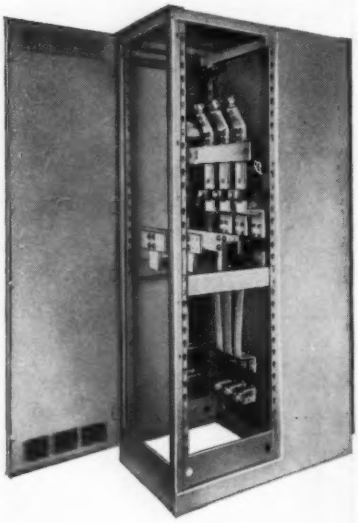
STILL THE MOST ADVANCED 600 VOLT SWITCHGEAR!

Four years ago, I-T-E introduced its completely new design advanced 600 volt switchgear with K-Line circuit breakers. In all this time right up to the present, no other gear modified or redesigned has been able to match it. Here still is today's most advanced gear, with easier operation, simpler upkeep, longer life, higher safety, and greater assurance of dependability than any other. Compare for yourself. For detailed literature, write I-T-E Circuit Breaker Co., Dept. SW, 1900 Hamilton St., Phila. 30, Pa.

Dependable drawout mechanism. Sturdy crank drive moves breaker on nonfriction rollers. Won't let you down when you need it most. Breaker can be padlocked in connected, test or disconnected positions. Door always remains completely closed for unequaled protection against dust contamination.

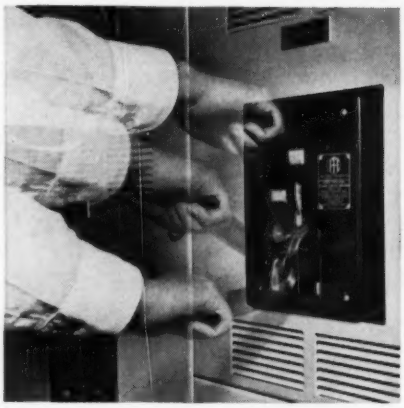


Complete isolation of breaker compartments. Each breaker is completely surrounded by solid steel barriers between it and other breaker compartments. No risk of arc gases contaminating an adjacent breaker through openings in partitions. Note also that secondary disconnects are located at the bottom of the compartment, safely removed from arc gases.



Silverplated bus. You pay no premium for this feature in I-T-E 600 volt switchgear. Aluminum bus is silverplated over its entire length for maximum conductivity. Reduces the required mass of the bus for a given maximum current. Bus is rigidly braced against movement in any direction from short circuits.

Easy-to-operate stored energy closing. Just pull down the handle, slow or fast as you please. Contacts close firmly in only 5 cycles for fast, uniform closure every time. Pulldown handle means easy operation of all breakers—top row, bottom row, or in the middle. Electrical closing mechanism, available optionally, uses a low current motor, not a solenoid.



I-T-E CIRCUIT BREAKER COMPANY